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IDAHO AND MONTANA

SIGHTS AND SCENES

VIA THE

UNION PACIFIC

THE OVERLAND ROUTE

FOR THE TOURIST

S. H. H. CLARK,
Vice-Pres. and Gen'l Manager.

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Ass't Gen'l Manager.

E. L. LOMAX,
Gen'l Pass'r and Tkt. Agt.

OMAHA, NEB.

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FOURTH EDITION

SIGHTS AND SCENES

IN

IDAHO AND MONTANA

FOR

TOURISTS.

MAY 27 1897

Compliments of the Passenger Department,

UNION PACIFIC SYSTEM,

OMAHA, NEB.

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By E. L. LOMAX, General Passenger and Ticket Agent,
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The Private Hotel, Dining, Hunting and Sleeping Cars of the Pull, man Company will accommodate from twelve to eighteen persons allowing a full bed to each, and are fitted with such modern conveniences as private, observation and smoking rooms, folding beds, reclining chairs, buffets and kitchens. They are "*just the thing*" for tourists, theatrical companies, sportsmen and private parties. The Hunting Cars have special conveniences, being provided with dog-kennels, gun-racks, fishing tackle, etc. These cars can be chartered at following rates per diem (the time being reckoned from date of departure until return of same, unless otherwise arranged with the Pullman Company):

LESS THAN TEN DAYS.

	Per day.		*Per day.*
Hotel Cars	$50.00	Private or Hunting Cars	$35.00
Buffet Cars	45.00	Private Cars with Buffet	30.00
Sleeping Cars	40.00	Dining Cars	30.00

TEN DAYS OR OVER, $5.00 per day less than above. Hotel, Buffet, or Sleeping Cars can also be chartered for continuous trips without lay-over between points where extra cars are furnished (cars to be given up at destination), as follows:

Where berth rate is $1.50, car rate will be $35.00
" " 2.00, " " 45.00
" " 2.50, " " 55.00
For each additional berth rate of 50 cents, car rate will be increased $10.

Above rates include service of polite and skillful attendants. The commissariat will also be furnished, if desired. Such chartered cars must contain not less than fifteen persons holding full first-class tickets, and another full fare ticket will be required for each additional passenger over fifteen. If chartered "per diem" cars are given up *en route*, chartering party must arrange for return to original starting point free, or pay amount of freight necessary for return thereto.

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are attached to the **Council Bluffs** and **Denver Vestibuled Express**, running daily between **Council Bluffs** and **Denver**, and to **"The Overland Flyer,"** running daily between **Council Bluffs** and **Portland** and **Council Bluffs** and **San Francisco.**

MEALS.

All trains, except those specified above (under head of Pullman Dining Cars), stop at regular eating stations, where first-class meals are furnished, under the direct supervision of this Company, by the Pacific Hotel Company. Neat and tidy lunch counters are also to be found at these stations.

SIGHTS AND SCENES IN IDAHO AND MONTANA.

Idaho is an Indian word signifying "Gem of the Mountains," a very appropriate term for the queenly young territory. It is 410 miles long, and 257 wide in the extreme south, and has an area of over 55,000,000 acres. There are 18,400,000 acres classed as mountainous, 15,000,000 agricultural lands, 7,000,000 acres of forests, 25,000,000 acres of grazing lands, and 600,000 acres of lakes. This may be well called an imperial domain, consisting, as it does, of 84,000 square miles. Idaho was admitted to the Union as a state July 3, 1890.

Idaho is in the same latitude as France, Switzerland and portions of Italy, Spain and Portugal. It is subject to oceanic influences very similar to those countries, and necessarily has a somewhat similar climate. All this region is near enough to the Pacific Ocean to be very noticeably affected by its currents.

The Union Pacific system will sell at greatly reduced rates, during the summer season, a series of excursion tickets called "Shoshone Tours," covering the principal points in Idaho and Montana, using Pocatello as a central point. Stop-over privileges will be given within the limitation of the tickets. Tickets will be good thirty days from date of sale, excepting the Yellowstone Park tickets, which will bear a limit of sixty days.

First Shoshone Tour: From Pocatello to Great Shoshone Falls and return to Shoshone Station; from Shoshone Station to Hailey (Guyer Hot Springs) and Ketchum and return to Shoshone Station, and from Shoshone Station to Boise City and return to Pocatello.

Second Shoshone Tour: From Pocatello to Soda Springs and return.

Third Shoshone Tour: From Pocatello, via Beaver Cañon, to Yellowstone National Park and return.

Fourth Shoshone Tour: From Pocatello to Butte and Helena and return.

In doing the circuit of these tours, the traveler will

GREAT SHOSHONE FALLS, IDAHO.—reached only via the Union Pacific System.

find it most advantageous to use Pocatello as a central point. It is a railroad town of 2,000 inhabitants, and lacks any particular charm in scenery or environment, but it is a very convenient point for headquarters while "doing" Idaho and Montana. The Pacific Hotel at the station will be found first-class in every particular. At Pocatello, connections are made with Montana on the north, south to Ogden, and east and west on the Portland Main Line of the Union Pacific.

The Pocatello townsite bill passed Congress September 1, 1888, ratifying the treaty of May 27, 1887. A bill was also passed February 23, 1889, ratifying the treaty of May 14, 1880, whereby 350,000 acres of land were ceded to the public domain. This tract covers the southern portion of the Fort Hall Reservation, taking in McCammon Station on the Union Pacific Railway. This magnificent tract is now ready for Government survey, and when thrown open to settlers will furnish fine homesteads for thousands of people.

The first tour is from Pocatello to Shoshone Station, and from there by stage to GREAT SHOSHONE FALLS, the wonder of this continent.

GREAT SHOSHONE FALLS.

It is a three hours' run from Pocatello to Shoshone Station. Not very promising looks the small but energetic town, and rather desolate the miles of sagebrush that stretch away to the southward, and it is twenty-five miles from the railway track to the Falls. The method of travel is either by stage-coach or private conveyance. Good teams there are in abundance, and the distance is made in three and one-half hours. But after one has driven the allotted time, there are no signs of the Falls; the same desert stretches around, and a purple mountain chain in the far south seems to be the ultimate goal. Within the last mile or so a few lava ridges have sprung up, and passing suddenly around one of these, we find ourselves in a natural gate, and there below, a sheer 1,200 feet, lies the Snake River, and then we hear for the first time the music of the Falls. A steep road brings us down to the ferry. The water here, 200 yards above the Falls, is over 200 feet deep, and of a greenish color. The ferry is a very substantial affair,

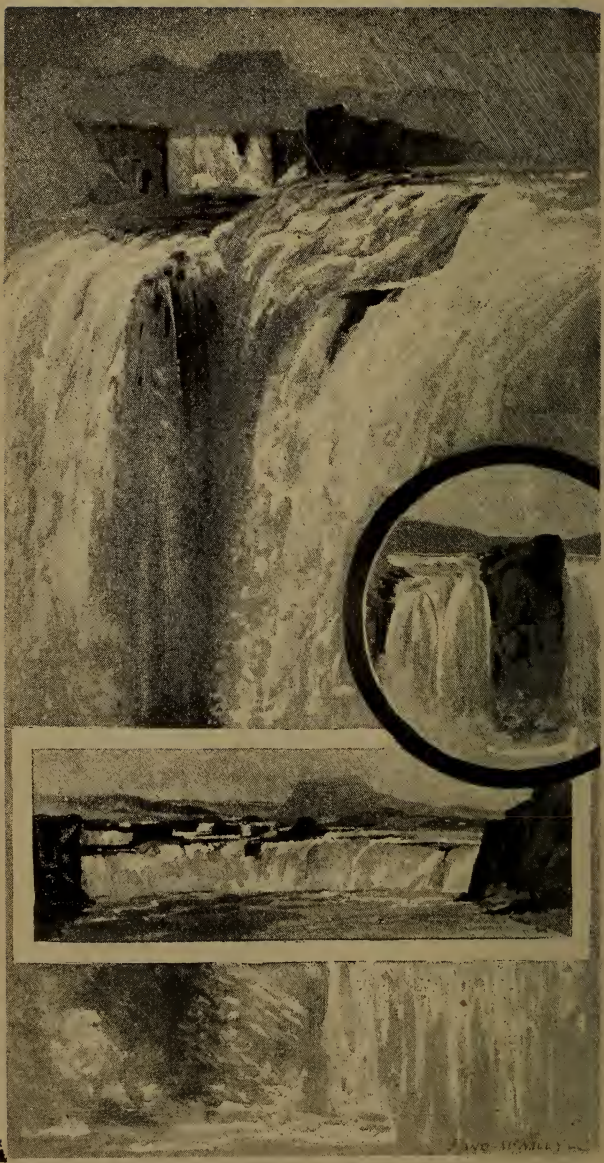
worked by an under-water wire cable, and another safety wire cable above, reaching from bank to bank. The cozy hotel is all that could be desired in *cuisine* and *menage*, and at the very door one stands and looks down at the Falls. Shoshone differs from every other waterfall in this or the old country. It is its lonely grandeur that impresses one so deeply; all of the other historic places have the adjuncts of civilization, and one is almost overshadowed by a city while in their presence. The encroachments of men have taken away from the charm of Nature. But Shoshone is as lonely as when first this rushing river sprang through those towering cañon walls. The height of the chasm above and below the Falls varies from 1,050 to 1,200 feet, and there is eighteen miles of this gorge. The fall proper measures 950 feet across, and the Bridal Veil, which is only a few yards back of the great fall, 125 feet. Down through this appalling rent the river plunges, takes a flying leap of eighty-two feet at first, and then falling thunderously 210 feet into the boiling basin below. It is three miles up the river to Twin Falls, six miles to Blue Lake, a charming bit of water seventy-five feet deep and as clear as crystal; one-half mile to the Vaulted Dome; one-half mile to the Locomotive Cave; a mile and a quarter to the lower Cascade Falls, and one and one-half miles to the Devil's Corral. The hotel is situated on the bank overlooking the Great Falls not twenty feet from the brink, and affords a view of Bridal Veil, Bridal Train, Natural Mill Race Falls, Eagle Rock, and Bell's Island.

One sunset at this enchanted spot will never be forgotten. The day began to die, and then came a wonderful display. As the sun went down the sky flashed into manifold colors—there were bars of violet, crimson, and delicate shadings of pink and salmon. For a few moments the sun hung over the great chasm below the Falls, flooding the majestic cañon walls with warm glows, and lighting up the Falls with surpassing brilliancy; the river flowed beneath, restless and seething after its mighty conflict. Down the red orb went behind the western cliff, and great flame-bursts and banners, many-hued, witnessed his departure. There was a pause—and then the pageant dissolved; cool amber grays crept across the dome and deepened into shadow; another mo-

ment the day was gone, and starlight upon us. But at night the place is haunted. The wave circles of sound are recurrent—at least two or three are—that one especially which resembles the thunder of a railway train at full speed. It will come roaring by and die away only to return again and again. The mystery and majesty of this great organ volume of sound are, at times, appalling. Remember, that the one solid theme of the thunder of the Falls never ceased—that was permanent and unvarying—but upon this monotonous theme were played a thousand variations. Once there was a steady tramp, as of a battalion of soldiers marching strongly and steadily together. This died away, and then two voices were heard, very far off, but distinct as if engaged in angry altercation; they sank down and the room became full of vague and shadowy whisperings, then the refrain would break out, clinkety-clank! clinkety-clank! ca-den, ca-den, boom, boom—boom, boom, boom (marching time). It was two nerve-trying, and we opened the window wide; the moonlight fell full on the Falls and lingered on the rent and ghastly sides of the cañon walls. A faint recurrence could be detected in the heavy bass movement of the symphony, if one may so call it, but otherwise there was nothing more than the powerful swish and roar of the water; but many a time through the night we heard those haunting voices, and weird, uncanny sounds.

Across the deep, green water we go again in safety; up the narrow road along the face of the cliff, and once more stand in the magnificent portal and look back. Serenely tower the cañon walls in the still summer air; placid and calm the river below; the thunder of the cataract heard dimly around to the right; golden sunshine falling tenderly on the torn and gashed outline of mountain wall and dreaming river—a dozen steps through the sharp defile, and the picture vanishes; there are no mighty deeps—no river, no gleam of falling splendor—the waste of the desert and the dreary miles of sage-brush creep away to the dim horizon on every side—addio, Shoshone, addio.

The character of the country through which the railway traveler passes in Southern and Eastern Idaho is adapted to repel rather than attract. The vast stretches of lava fields and sage-brush plains become monotonous in the extreme; yet amid Idaho's placid



GREAT SHOSHONE FALLS, IDAHO — reached via the Union Pacific System.

lakes, rushing rivers, and rugged mountains, may be found many a romantic scene. Rocks piled mountain high, cañons a thousand feet deep, through which streams rush, and roar, and foam, cataracts leaping from rock to rock, tossing their spray aloft, somber forest scenes beneath towering trees, where foliage is so dense as to leave a twilight dimness at mid-day—these are some of the characteristics of the landscapes of imperial Idaho. Chief among all, however, are the Great Shoshone Falls of Snake river.

"The three great falls of America," says Clarence King, "Niagara, Shoshone and Yosemite, all happily bearing Indian names, are as characteristically different as possible. There seems little left for a cataract to express."

The Shoshone Falls have been called the Niagara of the West. The title is not a fortunate one, as these falls have a superior scenery peculiarly their own. They are higher than Niagara, though during most of the year there is less volume of water. Probably the best description is that written by Mr. King himself, from which we make copious extracts without further apology. "A few miles in front, the smooth surface of the plain was broken by a rugged zigzag line of black, which marked the further wall of the Snake Cañon. A dull, throbbing sound greeted us. Its pulsations were deep, and seemed to proceed from the ground beneath our feet. Leaving the cavalry to bring up the wagon, my friend and I galloped on, and were quickly upon the edge of the cañon wall.

"We looked down into a broad, circular excavation, three-quarters of a mile in diameter, and nearly 1,000 feet deep. East and north, over the edges of the cañon, we looked across miles and miles of the Snake Plain, far on to the blue boundary mountains. The wall of the gorge opposite us, like the cliff at our feet, sank in perpendicular bluffs, nearly to the level of the river, the broad excavation being covered by rough piles of black lava and rounded domes of rock. A horizon as level as the sea; a circling wall, whose sharp edges were here and there battlemented in huge, fortress-like masses; a broad river, smooth and unruffled, flowing quietly in the middle of the scene, and then plunging into a labyrinth of rocks, tumbling over a precipice 220 feet high, and moving westward in a still, deep current, to disappear behind a black promontory.

FERRY AT GREAT SHOSHONE FALLS, IDAHO—reached via the Union Pacific System.

"It is a strange, savage scene—a monotony of pale blue sky, olive and gray stretches of desert, frowning walls of jetty lava, deep beryl-green river stretches, reflecting here and there the intense solemnity of the cliffs, and in the centre a dazzling sheet of foam. In the early morning light, the shadows of the cliffs were cast over half the basin, defining themselves in sharp outline here and there on the river. Upon the foam of the cataract, one point of the rock cast a blue shadow. Where the river flowed around the western promontory, it was wholly in shadow and of a deep sea-green. A scanty growth of trees fringed the brink of the lower cliffs overhanging the river. Dead barrenness is the whole sentiment of the scene. The mere suggestion of trees clinging here and there along the walls serves rather to heighten than to relieve the forbidding gloom of the place. Nor does the flashing whiteness where the river tears itself among the rocky islands, or rolls in spray down the cliff, brighten the aspect. In contrast with its brilliancy, the rocks seem darker and more wild.

"The descent of 1,000 feet from our standpoint to the level of the river above the falls has to be made by a narrow winding path among rough ledges of lava. We were obliged to leave our wagon at the summit, and pack down the camp equipment and photographic apparatus upon carefully-led mules. By mid-day we were comfortably camped on the margin of the left bank, just above the brink of the falls. My tent was pitched upon the edge of the cliff directly overhanging the rapids. From my door, I looked over the cataract, and, whenever the veil of mist was blown aside, could see for a mile down the river.

"The lower half of the cañon is excavated in a volcanic formation of red and gray rock. It is over this material that the Snake falls. Above the brink, the whole breadth of the river is broken by a dozen small volcanic islands, which the water has carved into fantastic forms; rounding some into low domes, sharpening others into mere pillars, and now and then wearing into deep caves. At the very brink of the fall, a few twisted evergreens cling with their roots to the rock, and lean over the abyss of foam with something of that air of fatal fascination which is apt to take possession of men. Under the influence of the cool shadow of cliffs and pine, and constant percolating of

THE THREE TETONS, IDAHO—Reached via the Union Pacific System.

surface waters, a rare fertility is developed in the ravines opening upon the cañon shore. A luxuriance of ferns and mosses, an almost tropical wealth of green leaves and velvety carpeting line the banks. There are no rocks at the base of the fall. The sheet of foam plunges almost vertically into a dark beryl-green lake-like expanse of river.

"Immense volumes of foam roll up from the cataract base, and whirling about in eddying winds, rise often a thousand feet in the air. When the wind blows down the cañon, a gray mist obscures the river for half a mile, and when, as is usually the case in the afternoon, the breezes blow eastward, the foam cloud curls over the brink of the fall and hangs like a veil over the upper river. On what condition depends the height to which the foam cloud rises from the base of the fall, it is apparently impossible to determine. Without the slightest wind, the cloud of spray often rises several hundred feet above the cañon wall, and again, with apparently the same conditions of river and atmosphere, it hardly reaches the brink. Incessant roar, re-enforced by a thousand echoes, fills the cañon. Out of this monotone, from time to time, rise strange wild sounds, and now and then may be heard a slow, measured beat, not unlike the recurring fall of breakers. From the white front of the cataract the eye constantly wanders up to the black, foaming parapet of lava. Angular bastions rise sharply from the general level of the wall, and here and there isolated blocks, profiling upon their sky line, strikingly recall *barbette* batteries. To goad one's imagination up to the point of perpetually seeing resemblances of everything else in the forms of rock, is the most vulgar vice of travelers; to refuse to see the architectural suggestions upon Snake Cañon, however, is to administer a flat snub to one's fancy. The whole edge of the cañon is deeply cleft in vertical crevices. The actual brink is usually formed of irregular blocks and prisms of lava, poised upon their ends in an unstable equilibrium, ready to be tumbled over at the first leverage of the frost. Hardly an hour passes without the boom of one of those rock masses falling upon the ragged *débris* piles below.

"Night is the true time to appreciate the full force of the scene. I lay and watched it many hours. The

broken rim of the basin profiled itself upon a mass of drifting clouds, when torn openings revealed gleams of pale moonlight and bits of remote sky trembling with misty stars. Intervals of light and blank darkness hurriedly followed each other. For a moment the black gorge would be crowded with forms. Tall cliffs, ramparts of lava, the rugged outlines of islands huddled together on the cataract's brink, faintly luminous foam breaking over black rapids, the swift white leap of the river, and a ghostly, formless mist through which the cañon walls and far reach of the lower river were veiled and unveiled again and again. A moment of this strange picture, and then a rush of black shadow, when nothing could be seen but the breaks in the clouds, the basin rim, and a vague white centre in the general darkness. * * *

"The cliffs around the upper cataract, or "Twin Fall," are inferior to those of the Shoshone. While the level of the upper plain remains nearly the same, the river constantly deepens the channel in its westward course. In returning from the upper falls I attempted to climb along the very edge of the cliff, in order to study carefully the habits of the basalt, but I found myself in a labyrinth of side crevices, which were cut into the plain from a hundred to a thousand feet back from the main wall. These recesses were usually in the form of an amphitheater, with black walls 200 feet high, and a bottom filled with immense fragments of basalt rudely piled together."

The Hon. C. C. Goodwin, of Salt Lake City, the well-known brilliant journalist, has described his impressions of Shoshone Falls so vividly and with such dramatic vigor, that his sketch is reproduced herewith. It is a fitting tribute to the "glory and the grandeur of Shoshone Falls," as Judge Goodwin aptly terms his beautiful description:

"The lava beds of Idaho are a marked feature of that Territory. Starting near the eastern boundary they extend southwesterly for a long distance, and are from 300 feet to 900 feet in depth. This mass was once a river of molten fire, the making of which must have succeeded a convulsion of Nature more terrible than any ever witnessed by mortals, and long years must have passed before the awful fiery mass was cooled. To the east of the source of the lava flow,

the Snake river bursts out of the hills, becoming almost at once a sovereign river, and flowing at first southwesterly and then bending westerly, cuts through the lava fields nearly in the center of the Territory, reckoned from east to west, and about forty miles north of its southern border, and thence flowing with great curves, merges finally with the Columbia. The two rivers combined make one of the chief waterways of the continent, and here and there take on pictures of great beauty. But there is only one pathway to the Great Shoshone Falls, and that is from Shoshone Station, on the Oregon Short Line Division of the Union Pacific.

"The Great Falls are twenty-six miles due south from the station, and may be reached in three hours by stage or private conveyance. Shoshone Station is a busy, wide-awake railway town of 958 people; it is 1,200 miles distant from Omaha; 1,427 from Kansas City; 788 from Denver; 298 from Salt Lake; 261 from Ogden; and 624 miles from Portland, Oregon.

"Never anywhere else was there such a scene; never anywhere else was so beautiful a picture hung in so rude a frame; never anywhere else, on a background so forbidding and weird, were so many glories clustered.

"Around and beyond, there is nothing but the desert—sere, silent, lifeless—as though Desolation had builded there everlasting thrones to Sorrow and Despair.

"Away back in remote ages, over the withered breast of the desert, a river of fire, 100 miles wide and 400 miles long, was turned. As the fiery mass cooled, its red waves became transfixed, and turned black, giving to the double-desert an indescribably blasted and forbidding face.

"But while this river of fire was in flow, a river of water was fighting its way across it, or has since made war and forged out for itself a channel through the mass. This channel looks like the grave of a volcano that had been robbed of its dead.

"But right between its crumbling and repellent walls, transfiguration appears. And such a picture! A river as lordly as the Hudson or the Ohio, springing from the distant snow-crested Tetons with waters transparent as glass, but green as emerald, with

majestic flow and ever-increasing volume, sweeps on until it reaches this point where the display begins.

"Suddenly, in different places in the river-bed, jagged rocky reefs are upheaved, dividing the current into four rivers, and these, in a mighty plunge of eighty feet downward, dash on their way. Of course the waters are churned into foam, and roll over the precipice white as are the garments of the morning when no cloud obscures the sun. The loveliest of these falls is called "The Bridal Veil," because it is made of the lace which is woven with a warp of falling waters and a woof of sunlight. Above this and near the right bank, is a long trail of foam, and this is called "The Bridal Trail." The other channels are not so fair as the one called "The Bridal Veil," but they are more fierce and wild, and carry in their ferocious sweep more power.

"One of the reefs which divides the river in mid-channel runs up to a peak, and on this a family of eagles have, through the years, may be through centuries, made their home and reared their young, on the very verge of the abyss and amid the full echoes of the resounding roar of the falls. Surely the eagle is a fitting symbol of perfect fearlessness, and of that exultation which comes with battle clamors.

"But these first falls are but a beginning. The greater splendor succeeds. With swifter flow, the startled waters dash on, and within a few feet take their second plunge into a solid crescent, over a sheer precipice, 210 feet to the abyss below. On the brink there is a rolling crest of white, dotted here and there, in sharp contrast, with shining eddies of green, as might a necklace of emerald shimmer on a throat of snow, and then the leap and fall.

"Here more than foam is made. Here the waters are shivered into fleecy spray, whiter and finer than any miracle that ever fell from an India loom; while from the depths below, an everlasting vapor rises—the incense of the waters to the water's God. Finally, through the long, unclouded days, the sun sends down his beams, and to give the startling scene its growing splendor, wreathes the terror and the glory in a rainbow halo. On either sullen bank the extremities of its arc are anchored, and there in its many-colored robes of light it lies outstretched above the abyss like wreaths of flowers above a sepulchre. Up through

the glory and terror an everlasting roar ascends, deep toned as in the voice of fate, a diapason like that the rolling ocean chants when his eager surges come rushing in to greet and fiercely woo an irresponsive promontory.

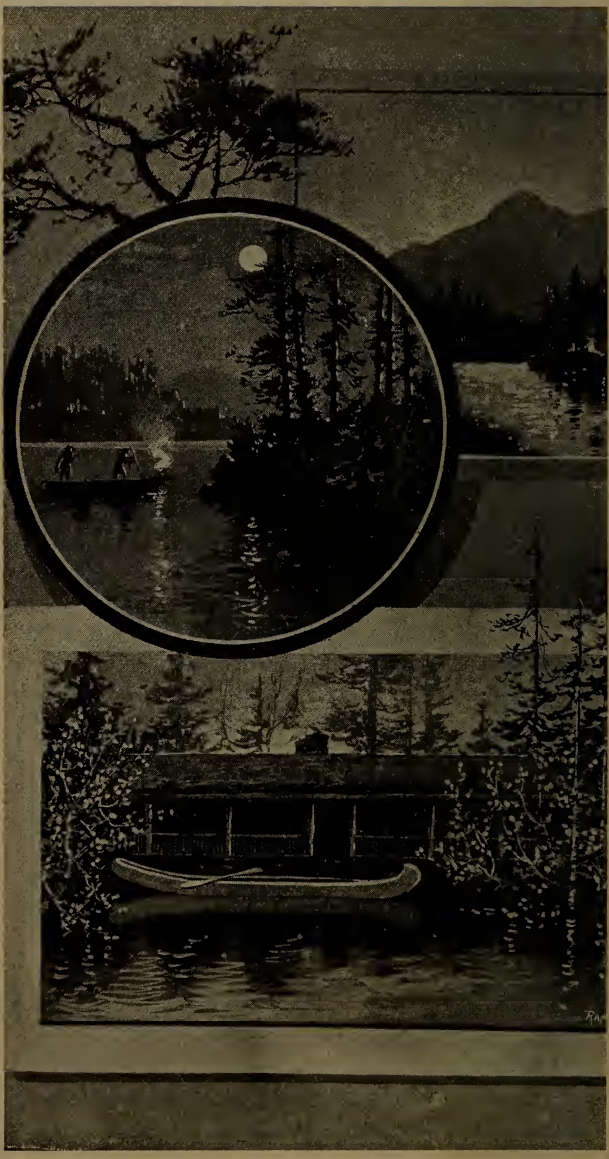
"But to feel all the awe and to mark all the splendor and power that comes of the mighty display, one must climb down the deep descent to the river's brink below, and pressing up as nearly as possible to the falls, contemplate the tremendous picture. There, something of the energy that creates that endless panorama is comprehended; all the deep throbbings of the mighty river's pulses are felt, all the magnificence is seen.

"In the reverberations that come of the war of waters, one hears something like God's voice; something like the splendor of God is before his eyes; something akin to God's power is manifesting itself before him, and his soul shrinks within itself, conscious, as never before, of its own littleness and helplessness in the presence of the workings of Nature's immeasurable forces.

"Not quite so massive is the picture as is Niagara, but it has more lights and shades and loveliness, as though a hand more divinely skilled had mixed the tints, and with more delicate art had transfixed them upon that picture suspended there in its rugged and sombre frame.

"As one watches, it is not difficult to fancy that, away back in the immemorial and unrecorded past, the angel of love bewailed the fact that mortals were to be given existence in a spot so forbidding, a spot that, apparently, was never to be warmed with God's smile, which was never to make a sign through which God's mercy was to be discerned; that then omnipotence was touched, that with His hand He smote the hills and started the great river in its flow; that with His finger he traced out the channel across the corpse of that other river that had been fire, mingled the sunbeams with the raging waters, and made it possible in that fire-blasted frame of *scoria* to swing a picture which should be first to the red man and later to the pale races, a certain sign of the existence, the power, and the unapproachable splendor of Jehovah.

"And as the red man, through the centuries, watched the spectacle, comprehending nothing ex-



APPROACH TO YELLOWSTONE NATIONAL PARK.

Reched via the Union Pacific System.

1. Ford at Snake River. 2. Spearing Trcut, Snake River.
3. Hunter's Cabin, Henry's Lake.

cept that an infinite voice was smiting his ears, and insufferable glories were blazing before his eyes; so, through the centuries to come, the pale races will stand upon the shuddering shore and watch, experiencing a mighty impulse to put off the sandals from their feet, under an overmastering consciousness that the spot on which they are standing is holy ground.

"There is nothing elsewhere like it, nothing half so weird, so beautiful, so clothed in majesty, so draped with terror, nothing else that awakens impressions at once so startling, so winsome, so profound. While journeying through the desert, to come suddenly upon it, the spectacle gives one something of the emotions that would be experienced to behold a resurrection from the dead. In the midst of what seems like a dead world, suddenly there springs into irrepressible life something so marvelous, so grand, so caparisoned with loveliness and irresistible might, that the head is bowed, the strained heart throbs tumultuously, and the awed soul sinks to its knees."

THE BLUE LAKES (Shoshone Falls).

While Shoshone Falls itself is full of varied and never ceasing interest and wonder, its environments afford much to attract the tourist or the student of nature. One can spend a profitable day examining the peculiar lava formation as exhibited in the rugged walls of the Grand Cañon of the Snake River, both above and below the main falls, where they leap into the seething abyss 220 feet below the great precipice. Going up the channel three miles are found the Twin Falls, rushing through a gorge, walled in by the lava and divided into two narrow streams, which shoot over the face of the rugged rocks side by side, and, with a mighty roar, leap 180 feet downward in one desperate plunge into the mysterious surging depths below. All around is seeming chaos, and such a weird, powerful, gigantic presence surrounds the visitor that he is overcome with awe, while in close proximity to either the Main Falls or the Twin Falls.

So that when filled by this inexpressible majesty and power, and almost dazed by the constant roar and rush of waters, it is a relief to turn toward a peaceful, quiet little spot known as the BLUE LAKES, about four miles below the falls. These little lakes are on

the north bank of Snake River, and are reached by a wagon road, by making a slight detour from the stage line to the falls. The lakes, and several hundred acres of land adjoining, are the property of I. B. Perrine (of Shoshone), who has improved the place by stocking the lakes with speckled trout, and by planting several thousand peach and other fruit trees. For trout fishing few better points can be found. The waters are perfectly placid and still, shut in, as they are, by a semi-circular amphitheatre near the bank of the Snake River, several hundred feet below the level of the plains on either side. After a row on the lake and an exciting time landing the finny tribe, one's appetite begins to make demands, and what better lunch could be served than a bowl of fresh Idaho strawberries and cream, during the latter part of April or in May? or, later in the season, a plate of peaches or juicy melon, from the garden close by? The orchard contains about four thousand peach trees alone, besides grapes, apples, and small fruits. These are now bearing. Added to the beauty of the lakes, the boating, the fishing, the unfailing system of irrigation, which produces such wonderful results in the desert places, all these will serve to interest and instruct the traveler who visits the Blue Lakes.

An extensive canal system has been proposed to irrigate the vast plains between the Oregon Short Line and Shoshone Falls, but at present the Blue Lakes are fed by subterranean streams underneath the lava beds, and these streams furnish the water to irrigate the farm at the lakes, which is truly an oasis in the desert.

Returning to Shoshone Station, the train is taken to Hailey, and the famous Hot Springs visited.

HAILEY.

Hailey is situated just where Quigley and Croy gulches unite with the Wood River Valley, the junction affording a fine view in four directions, embracing well-cultivated ranches, and ending with the foot-hills. The climate is mild and even, and the roads, stretching away on all sides, are perfect. The mines at Hailey possess much of interest to the tourist, and a good hotel furnishes accommodations.

One and a half miles from Hailey are the famous

Hailey Hot Springs. The ride or walk thither is very pleasant, leading through a picturesque little valley, and the location, in a lovely glen in sight of several rich mines, is very pleasing. Large volumes of water of a temperature of 150° and containing sulphate of soda, iron, magnesia, sulphur, and other desirable ingredients, are found in scores of springs. Commodious swimming-baths are provided. Many patients have gone to these with chronic cases, believed to be hopeless, of neuralgia, paralysis, dyspepsia, inflammatory or mercurial rheumatism, and other complaints for which the Arkansas springs are considered a specific, and after a few months of bathing and drinking have left completely restored. The baths are also very popular with those in good health, thousands visiting them annually for the delightfully exhilarating effects of a plunge.

The largest hospital of Alturas county is near. A two-mile drive from Hailey takes the tourist to the beautiful valley of Croy Gulch, with an altitude of about 5,300 feet. The Bolton Hot Springs, five miles from Hailey, are also very efficacious in relieving and curing rheumatism. Bellevue, five miles south of Hailey, is a pretty little town.

KETCHUM.

Ketchum, a rapidly growing town of about 400 to 500 people, lies thirteen miles north of Hailey, and is beautifully situated at the head of the Wood River Valley. At this point, Wood river is as clear as crystal, and rich in the finest of mountain trout. The vicinity surrounding affords good hunting, and elk and bear abound. The mines round about Ketchum are large, and will well repay inspection. The Guyer Hot Springs, two miles by stage from Ketchum, are noted for their medicinal waters, and are of high repute throughout the neighboring country. There are many objects of interest, both for the tourist and pleasure-seeker, in and about Ketchum. The scenery is beautiful, and the climate all that could be desired.

GUYER HOT SPRINGS.

This romantic little mountain resort is situated about two miles from Ketchum and seventy miles

from Shoshone. Regular hacks run to and fro from the springs, in connection with the branch trains. The springs are comparatively unknown outside of Idaho, but are destined to become famous for the well-known medicinal qualities of the waters and the great natural beauty of the place. The springs, about fifteen in number, gush out from the mountain-side intensely hot, and are conveyed a short distance by pipe to the bath-house, where there are two large plunge baths and quite a number of single rooms with tubs. The waters are good for all nervous complaints, rheumatism, skin and blood affections. This place is much resorted to by tourists and invalids. It is a beautiful, quiet mountain retreat. The accommodations for guests are first-class, and in addition to the hotel, there are bath-houses, bowling-alleys, croquet and tennis grounds, swings, band-stands, and dancing-platforms—everything, in short, to make a visit pleasant.

BOISE CITY AND RETURN TO POCATELLO.

From Shoshone Station, passing westward, the next town of importance is Boise City, which is now reached from Nampa on the Union Pacific Railway, via the Idaho Central. Boise City is nineteen miles from Nampa, and has an elevation of 2,840 feet. It has a population of 2,311, good hotel accommodations, and is a point of interest to the tourist. Boise City is the largest, wealthiest, and most attractive town in the Territory, with good schools and pleasant homes. It is in the center of the Idaho fruit-belt. A great many medicinal springs are to be found within the immediate neighborhood of Boise City, easy of access, and possessing many charms, both of water and scenery.

It is over half a century since Fort Boise was established on the west side of Snake river by the Hudson Bay Fur Company. It was only a trading post for the trappers, and was so called because of the Boise (wooded) river emptying into the Snake opposite that point. All traces of the French-Canadian trappers who caught otter, beaver, and other animals in those days have passed away; but the country is still marked by names given by them to the streams, mountains, and localities.

Climate and general aspect have not changed, except as the savage inhabitants and wild beasts have been driven back by the influx of civilization, which has changed the broad acres into fruitful fields and orchards, dotted the plains with enterprising and thrifty towns, cities, and homes, and is fast making this land one of the garden spots of the world. With this civilization came those great aids of wealth and progress, the railways and telegraphs, exerting an influence beyond calculation.

The first settling of Idaho came from the finding of gold, and the stampede which followed to the Oro Fino country in 1861 and 1862. This mining excitement in the north caused prospecting southward, and in the following year Boise Basin and the Owyhee countries had their mining excitements, bringing hundreds of prospectors from the camps of California, Nevada and other districts.

The site of Boise City offered such favorable inducements for a town that it at once became a trading point and winter quarters for the placer miners who wanted a pleasant place to remain during the season of inactivity in the placers. Boise City thus became the commercial town of Idaho, and in the organization of the county became the county seat, and, very appropriately, is the capital of the territory.

Boise City is situated on the north side of Boise River, about fifty miles above its confluence with Snake River. On what was once a sage-brush plain, apparently almost a desert, such as constitutes so vast an area of western territory, clear-sighted American grit and enterprise have, within a little over twenty years, built a town which is the pride of its citizens and admiration of strangers. This was done when a railway was not within 300 miles, and all supplies had to be hauled these hundreds of miles across plains beset with apparently insurmountable difficulties. The railway came nearer only a few years ago, making a great change, and now the Idaho Central branch of the Union Pacific Railway has come to the very doors of the town, citizens have all the advantages of other places, and will soon forget the privations of the past.

The growth of Boise City, from the first down to the present, has been steady and sure. It has been a healthy growth, without a boom at any time, and has

never been affected by temporary excitements, but has advanced year by year permanently, each being an improvement over the former year.

The streets are wide and clean, and have good crossings, and the dense growth of shade trees on each side of all the streets makes the avenues delightfully shady and pleasant. The business part of the town is substantially built with brick and stone, a city ordinance forbidding the erection of wooden buildings within certain limits.

Five miles above Boise City, up the Boise Valley, are a dozen or more hot springs. Some are boiling hot, while others are moderately warm. The water possesses great medical qualities, and persons afflicted with rheumatism, paralysis, malaria or any chronic diseases are sure to find relief in a short time after bathing in these springs. Steam baths, mud baths, tub and plunge baths are supplied, and the doctors who are acquainted with the curative properties of these waters pronounce them equal to the Arkansas hot springs, Paso Roble, in California, or any springs in the world, and recommend them with great favor to patients. The conveniences and accommodations for guests at these springs will be largely improved another season, and they will soon become the Saratoga of the Northwest. Nature has made it a place of great curiosity, and the waters have always proved so beneficial that the springs only need to be known to become famous. The drive to the springs is through a thickly settled portion of the suburbs of the city, studded on either side by beautiful orchards and groves, laden at the proper season with the most delicious fruits. The United States penitentiary is passed a quarter of a mile to the left, when we soon come near the river bank, where a bluff two miles or more in length forms the immense stone quarries that furnish building material for Boise City and Southern Idaho. We next reach the large farm and stock ranch which belongs to the springs property, the springs lying in a large cove or gulch to the right, a portion of the water falling over thirty feet in height, forming a picturesque appearance, causing admiration and astonishment to the beholder. This is one of

the loveliest drives out of Boise City, and a place of great resort for the people of the city and visitors who come to the capital. Fish ponds, groves, orchards and places of amusement are in course of construction, and the bountiful supply of the table from the dairy and farm products of the proprietor will make it a desirable place to spend the summer months, while the hunting and fishing grounds in the hills and mountains near by and up the Boise River will furnish ample sport to all who enjoy the rod and gun.

The second tour is from Pocatello to

SODA SPRINGS.

This famous resort has become well known to tourists only within the past few years. The new hotel, the Idanha, elegant and commodious, meets all requirements for ease and comfort, while the sanitary effects of the waters are incomparable.

Soda Springs has an elevation of 5,780 feet above sea level, and is 1,021 miles from Omaha, 798 from Portland, 258 from Salt Lake, and 221 from Ogden. There are trains by way of Pocatello or Granger; and through passengers may reach it from the east or west. The temperature is beautifully even and mild in summer. These springs have been known of men for above half a century. The Spaniards were here, we know; because at the Cariboo Mines, fifty-five miles north, weapons with the mark of Spain upon them have been found. The Indians have always held the springs in great veneration, and Brigham Young blessed them when he visited the place in 1868. It is more than probable that the first white men of recent times who were here were members of the old Rocky Mountain Fur Company. A party of them were at Salt Lake in 1824 and wintered there. They made explorations north, and traced the course of several rivers in the adjacent territory, but we have no record of a visit to Soda Springs. In 1826 many trappers and hunters were exploring the Yellowstone and Bear Rivers, and it is supposed visited here. The springs were a favorite spot in the early fifties for overland travelers to stop and recruit, and all through the later years, when the great trains of gold-seekers and emigrants passed over the old Oregon trail, they paused at Soda Springs to refresh themselves and rest their jaded horses and cattle.

APPROACH TO YELLOWSTONE NATIONAL PARK, SOUTH FORK OF THE MADISON.—Reached via the Union Pacific System.

There are no Indian legends connected with the springs. The modern noble red man regards these bubbling miracles as "big medicine," and refuses to drink of them. They would go miles to get fresh running water rather than touch the springs. Soda Creek runs sparkling down and empties south into Bear River. The basin in which these springs are located is about twelve miles long by four wide. The area of spring district usually visited is about six miles by three, but the whole country is impregnated for a long distance away up to Blackfoot. There are but few springs of any consequence north of this point—that is, into the upper country of Montana and the adjacent mountain country.

There are thirteen springs within a radius of one-half a mile from the hotel—the first one, 200 feet from the hotel, bubbles from the top of a conical mound. Swan Lake, six miles east, is a beautiful sheet of water of unknown depth; Formation Springs, five miles northeast, shows some curious effects of lime deposit, petrifying moss leaves and twigs perfectly. Hooper Spring, one and one-half miles distant, is a beauty; but all pale into insignificance before the Mammoth Spring. This is five miles from the station. The road leads one to a level stretch of prairie covered with waving grass rimmed in by foothills. One walks to the very margin of the spring before it is discovered, so completely is it hidden. And there within a circle of a few yards a dozen springs form a pool. The water is intensely blue and very deep. Looking down into those unfathomed depths one sees, in brilliant contrast to the color of the water, a white column cleave its way up from its mysterious home and break in beaded jets upon the surface. There is a weird fascination in watching it, and to drink at this fountain is to taste Nature's champagne. This spring and the Hooper are very strongly charged, and offer a most delicious beverage. Chlorlde of sodium, bicarbonate of magnesium and bicarbonate of calsium predominate, and an excess of free carbonic acid gas. The health-giving properties of the waters are widely known, and are recommended by the faculty as a specific for indigestion, stomach and kidney troubles, etc. Springs near the station are strongly tinctured with iron, and are an effectual remedy for thin blood, ladies in delicate health, etc.

The "Idanha" water is bottled at the works about a mile from the station. Many charming excursions can be arranged from Soda Springs. There is fine fishing on all sides, mountain climbing for those who desire it, plenty of sport in duck shooting, and an infinite variety of lovely drives in every direction.

Beyond the possibility of a doubt, those bright, sparkling waters, bursting forth from the earth in a hitherto but little known valley of Idaho, and now bearing the name of Soda Springs, are yet to become of world-wide celebrity. When the Union Pacific Company built the Oregon Short Line from Granger westward, passing through the secluded valley and within a few feet of many of the springs, the destiny of the place was changed. Henceforward, instead of being sought by the few whose knowledge of the virtues existing in the waters led them to this out-of-the-way place, it was to be in the reach of the many; its springs to be as a magnet to attract the afflicted from every State, and to yield to thousands the boon of health regained. Yet, as was said by the Salt Lake *Daily Tribune* in its account of the springs in 1887: "Of the tens of millions of people who inhabit the United States east of the Rocky Mountains, probably not one in a thousand has heard of the Soda Springs in Idaho Territory; probably not one in ten thousand has any idea of their rare medicinal properties, and not one in a hundred thousand realizes that, in comparison with them, all the famous spas of the old world sink into insignificance."

But for all that, they were not entirely unknown even in days long past. "From time immemorial the virtue of these waters was known to the Indians; they were officially reported by General Frémont in his explorations of 1843; they afforded health and invigoration to thousands who came 'across the plains' in later years; they were discovered by the Mormon explorers when they penetrated into the northern country, and were afterward solemnly blessed by Brigham Young. Their local reputation as a health resort has always stood high, and many have been the praises heaped upon them." Now, however, the Union Pacific has made them easily accessible from all points; "the journey that required four months of incessant toil and hardship from the East to the springs, a palace car makes easily and

without a jar in one and a half days, while the route between the springs and the Pacific is compassed in the same luxurious way in two days."

But it is of the waters we were about to speak: The importation of table waters from Europe is immense, and the statistics showed two years ago that there were twice as many thousand cases of Apollinaris sold in New York alone as the custom house showed was imported from all Europe, leaving the deduction that at least half the so-called Apollinaris sold in the United States is bogus. Beside, the Apollinaris is charged with gas to give it life. A large quantity of other water, ostensibly from other European and American springs, is also sold. Now it is known that the Soda Springs water equals or excels the best of them. The waters, as stated by the *Tribune*, "are charged with bicarbonate of soda, bicarbonate of potash, chloride of sodium and potash, sulphate of magnesia and lime, alumina, silica, carbonate of iron, free carbonic acid gas, and a multitude of other ingredients, and they are almost specifics for the cure of all manner of indigestion, all kidney troubles, up even to advanced symptoms of Bright's disease, and diabetes, dropsy and a thousand kindred ills; they take away all appetite for spirituous liquors, and the water is the pleasantest for table use that has ever been found." Lately, about two years ago, "the Soda Springs Water Company was organized, and a series of scientific and mechanical experiments, continuing through several weeks, were carried on until the secret of bottling the water and retaining all its pleasant and medicinal properties was caught; and now the water is on sale in all towns of the surrounding country, and the trade has so rapidly extended, east and west, that it is believed it will practically drive out of use the water from European spas before the close of the present year." They are now bottling two million quarts every twelve months.

The splendid new hotel erected and owned by the National Mineral Water Company, and now leased by the Pacific Hotel Company, was opened for the reception of guests June 1, 1888.

The Idanha is first-class in all respects; with all the modern improvements; water, electric lights, electric bells, etc. It has ample accommodation for 150 guests. All passenger trains stop at its very

PULPIT TERRACES, MAMMOTH HOT SPRINGS, YELLOWSTONE NATIONAL PARK.—reached via the Union Pacific System.

doors, and every attention will be paid to those honoring the new hotel with a visit. Rates will be from $3 per day upward, with special rates for parties or families, or those contemplating an extended stay. Livery service and attentive guides always to be procured at reasonable rates.

Soda Springs occupy a valley in a depression in the Wahsatch Mountains, at an altitude of about 6,000 feet. Around them the lofty peaks of the mountains are covered with perpetual snow. The region is full of interest, not to the geologist alone, but also to the ordinary sightseer. The number of springs, each with an individuality of its own, is amazing. Among the prominent and the curious we may specially name the following: The Idanha, the Hooper, the Mammoth, the Eye Water, the Brigham, the Lime Kiln, the Champagne, the Steamboat, the Formation Spring and Cave, and Swan Lake.

All the springs should be seen by persons wishing to realize the strangeness of the Soda Springs region. At different periods the under currents have changed their place of emergence, until the whole country shows traces of the limy deposits.

At the Idanha the Natural Mineral Water Company have their bottling works, and of the waters they bottle annually over two million quarts. The Hooper is a glorious spring, bursting out of the earth in a great volume of crystal clearness, sparkling brilliantly in the sunlight as it hurries away to form the greater part of Soda Spring creek. Its waters contain a somewhat larger percentage of iron than the Idanha, and differs somewhat in taste from that peerless spring. The Steamboat received its name in the early days, being described in the old guide books to California and Oregon. Its hot, jetting water gives off a noise of escaping steam exactly like the regular puffing of a steamboat. Formation Spring is particularly novel, and the cause of the name is a deep, well-like hole descending into the earth at an acute angle, being merely the crater of an extinct hot spring. Swan Lake is one of the most beautiful as well as most strange of all the springs; every effort to sound its depths has so far been unavailing; its waters are delightfully clear and of a deep green color. Oval in form, it is slightly more than sixty feet by forty feet across. On the west side the water trickles over a

bank thirty-five or forty feet high, which has been formed by the water itself, highly charged with lime, leaving a residue as the waters evaporated in the summer sunshine. Around the margin bushes and willows grow, and where the overhanging branches drop into the water they have become covered with the limy formation. Wagon loads of specimens, leaves, twigs, grasses, all intermingled in a net-work of stony embroidery, have been collected from the locality, and now adorn the cabinets of those prizing such freaks of nature, all over the land.

While mentioning the places of interest to be visited, we must not forget to mention the Big Bend of Bear river, about five miles from the hotel, and the crater of an extinct volcano, a few miles farther away. This volcano, when in an active state, poured its molten lavas down into the cañon of the Port Neuf, and out onto the Snake River plains beyond.

The region around Soda Springs may be said to be a paradise for the fisherman and hunter. Bear River always yields a fine reward to the lover of rod and line; what is known as Eight-mile Stream is even better, while the Blackfoot Creek, a tributary of Snake River, is without an equal for trout in all the country round; it is the trout stream par excellence. Of game there is the following: Ducks, prairie chickens, sage hens, geese, and swans. In the season thereof, ten to twelve miles from the hotel, among the spurs of the Wahsatch Mountains, deer and elk are quite plentiful, and the nimrod, if he so desires, can know what it is to face the bear. Those specially fond of duck shooting should note the following: A party from Butte City, Mont., last fall, in a two days' hunt, secured 500 ducks, besides something between thirty and forty geese. The fisherman fares equally well, and in hunting for the larger game the results are always fine.

CHEMICAL ANALYSIS OF THE SPRINGS.

The following analysis of Horse-shoe or Codman Spring was made by Mr. H. B. Hodges, Chemist and Engineer of Tests, Union Pacific Railway:

Specific Gravity	1.0501 at 15 Co.
Temperature of Spring	57° F.
One gallon contains in solution:	
Carbonate of Lime	74.64 grains
Carbonate of Magnesia	.72 "
Carbonate of Iron	2.59 "

Carbonate of Manganese	.08 grains.
Sulphate of Lime	1.13 "
Sulphate of Magnesia	33.59 "
Chloride of Magnesia	.72 "
Bromide of Magnesia	.03 "
Silica	3.71 "
Alumina	.18 "
Bicarbonate of Ammonia	.20 "
Bicarbonate of Potash	5.48 "
Bicarbonate of Soda	2.65 "
Chloride of Lithium	Trace
Total	134.72 "
Total Carbonic Acid	178.13 "

1 Liter contains 1,543 c. c. of Free Carbonic Acid.

This analysis was sent to Prof. E. S. Wood, of Harvard Medical School, who records his opinion as follows:

HARVARD MEDICAL SCHOOL, CHEMICAL LABORATORY,
BOSTON, MASS., April 19, 1889.

The Codman or Horse-Shoe Spring water is very decidedly a chalybeate water and also a laxative one. It contains about twice as much carbonate of iron as the Saratoga High Rock Spring, more than twice as much as the Saratoga Hathorn Spring, and about the same as the Saratoga Pavilion Spring, all of which are highly praised as furruginous waters, as you are undoubtedly aware.

The water of the Codman Spring resembles, as far as the amounts of lime, magnesia and iron are concerned, the water of the famous Kissingen Springs of Germany, which are extolled as tonic and laxative waters. These waters contain, however, also considerable quantities of common salt, while the Codman Spring water contains none.

I have no hesitation in saying that the analysis of Mr. Hodges shows that the water of the Codman or Horse-Shoe Spring possesses greater tonic and laxative properties than that of many mineral springs which have received a world-wide reputation as tonics and laxatives. (Signed) EDWARD S. WOOD.

The following analysis has been made of the various springs in and around the town of Soda Springs:

	Temperature.		Total Solids	Iron.	
	Water.	Air.	per U. S. Gal.	Protoxide.	Carbonate.
			Grains.		
Codman Spring	57 F.	....	134.72	.....	2.59
Hooper Spring	52 F.	57	79.95	1.20	2.91
Idanha Water (90) S'g	.....	....	87.70	.....	1.50
Mound Hot Spring	83 F.	66	197.98	.....	.....
Steamboat Spring	52 F.	....	191.55	.....	.....
Roland Spring	52 F.	....	170.50	.....	.....
Octagon Spring	56 F.	....	130.80	.98	2.11
Williams Spring	61 F.	....	139.86	1.14	2.50
Meadow Spring	.....	....	.....	.44	.91
Triplet Spring	.....	....	.....	.27	.51
Sulphur Lake Spring	.....	....	93.50	.....	.....

FALLS OF THE YELLOWSTONE, YELLOWSTONE NATIONAL PARK.

Reached via the Union Pacific System.

MONTANA

Is an Indian word meaning "the country of the mountains," and was visited by the French explorer Verendrye and his brother as early as 1743-44. The Lewis and Clarke expedition was here in 1805, and named the three forks of the Missouri respectively, Gallatin, Madison and Jefferson. This region was a part of the Louisiana purchase of 1803. The Territory was organized May 16, 1864, and admitted into the Union in November, 1889, and is in extent 550 miles from east to west, and nearly 300 from north to south, containing an area of 150,000 square miles. There are 16,000,000 acres of farm land, 38,000,000 acres of grazing land and 14,000,000 acres of forest. One-fifth of the territory, or about 20,000,000 acres, mountainous.

The third tour is made from Pocatello to Beaver ñon, where the traveler outfits for Yellowstone Park.

When Yellowstone National Park was set aside to e forever the grand tourist resort of the people, and heir common property, few had an idea of the end- less variety and stupendous grandeur of the features embraced in this tract of country, fifty-five by sixty-five miles. The park embraces an area of 3,000 square miles, has an average elevation of about 8,000 feet above sea level, and is encircled by magnificent mountain ranges.

THE APPROACH TO YELLOWSTONE PARK.

By entering the Yellowstone National Park by the Beaver Cañon Route, the tourist is taken direct into the midst of the marvelous sights of that paragon of wonders. Instead of finding himself seventy-five miles away from any other features of the park (as he does at Mammoth Hot Springs), he is landed at the Lower Geyser Basin, the true pivotal point for the various basins, the lake and the Grand Cañon. The starting point for this desirable route is from the Beaver Cañon Station, on the Utah and Northern Division of the Union Pacific System, and thence forward through a country attractive in the highest degree with river, mountain, cañon and lake scenery. The terminus is in the Lower Geyser Basin at the hotel, within sight of the Great Fountain Geyser.

The advantages of this route are easily seen. Without really doing extra staying, the traveler is made familiar with a portion of the West which is of great interest. He sees the celebrated Tetons, Henry's Lake, the birthplace of an important branch of the Snake River; that river itself, where it rolls, a clear, glassy stream through pine woods; the Tyghee Pass, the south fork of the Madison, and is brought into the very heart of wonderland.

The start is made in the morning. We traverse the Camas Meadows, from whence the Tetons are first seen; the Antelope Valley, ford the Shot Gun River, and at sundown are at the night station on the banks of the Snake River.

The Snake River is here no longer a turbid stream, flowing between walls of basalt, but bright, clear and glassy, gliding between banks intensely green, and its sliding mirror broken only by leaping trout.

"Of all the lovely spots to invite the tourist to linger in," says one who has been over the route, "none seemed so inviting to me as this. The smooth, glassy river swarms with the finest trout, the screech of the wild fowl is heard, game of the wilder sort, such as elk, bear and deer, roam over the mountains near by. The log hut is embellished with the skins of grizzlies, elk and other animals. This is a good spot to let your own camping outfit have a rest and try the repast served up. Trout and venison are the staples, and no stint. Travelers seem to gain wonderful appetites when they reach this place.

"One of the attractions here is

THE CATCHING OF TROUT

With a spear. A fire of pitch pine wood is placed on an elevated grating in the bow of a flat-boat. The light attracts the fish, and the nimble operator spears the finny beauties with barbed spears. The night before I arrived there a gentleman caught 1,002 fish in one night. The lot weighed nearly 1,500 pounds. They are shipped to Butte, Pocatello and other points on the Utah and Northern, and must prove very remunerative to the parties interested."

On the second day we are carried through pine woods by the Snake River, by Henry's Lake, up Tyghee Pass, and thence to the south fork of the Madi-

son and into the park by sunset. All of the places we describe in their several places.

HENRY'S LAKE.

Henry's Lake is best seen as we commence to ascend the foot-hill leading up toward Tahgee Pass, where it presents a beautiful appearance, lying in its deep basin, to the northwest surrounded by bold, picturesque mountains, a branch of the Rockies. It forms one of the sources of the Snake River—the Henry's Fork, which we see winding its sinuous course through the basin at our feet, "Across a long stretch of plashy meadow, interspersed with pools and netted with rivulets, a haunt for all the birds who love the shallow stream and grassy plain" on its way to join its brother stream that comes glancing down from the Tetons, away on the southern horizon.

The Lake is situated in the center of a most interesting region—one of scenic beauty. To the north is the range of mountains which divides its basin from that of the Madison River, and through which the latter stream cuts its way in forming the middle cañon; south is the great basin, stretching out toward the Wind River Range, and last the wooded mountains pierced by the Tahgee Pass, and west the mountains whose bold configuration has been already mentioned, and of which Sautelle Peak, an extinct volcano, is the principal eminence.

"Henry's Lake is a fine illustration of a remnant, dating back probably to the pliocene times, when all the valleys of this region were filled with water, perhaps connecting the drainage of the Missouri with that of the Columbia, and, as the waters subsided, formed the great chain of lake basins along all the important streams on both the Atlantic and Pacific slopes, of which our present lakes are only insignificant remnants.

"The view from the mountains back to the north is very fine, and is described at length in the U. S. survey of the Hayden party. As it describes an important scene, we append it:

"The view down Henry's Fork was remarkably fine. The air was clear and pure, and the valley to the junction of the Snake River was spread out like a picture, while the magnificent range of the Tetons,

full fifty miles distant, seemed not half that far away. Henry's Lake was at our feet ; shallow and full of little islands, only a remnant of its former self. To the west there is a beautiful grassy valley, with a small stream that flows into Henry's Lake (Goose Creek); this valley leads up to the divide, from which the west fork of the Madison take its rise. South of the valley there is a belt of metamorphic rocks extending far off to the west, rising 800 to 1,200 feet above the lake. On the south side, and extending to the southwest toward Red Rock Lake, is another valley which forms a beautiful pass. The long belt of mountains between the two passes is grassed over or thickly wooded with pines, while the range on the south side of the lake, which extends off in a southern direction from Henry's Fork Valley, is heavily timbered. This is a fine range, and at the same time covered with patches of snow. The first peak to the east is about 10,000 feet, the second peak 10,500 and the third peak in the range 10,000 feet. This will afford some idea of the general elevation of these mountains.

"To the east the mountains generally bend down to the valley, but are covered with a dense growth of pines. Far southward extends the valley of Henry's Fork—a marvel of beauty and freshness. The upper portion, for an extent of twenty to twenty-five miles in length and from five to ten miles in width, is like a meadow, covered with a luxuriant growth of grass, while flowing from the lake and winding through the middle of the valley, receiving on either side numerous branches, is Henry's Fork. Still farther southward is a dense black mass of pines, and just on the dim horizon, more than one hundred miles distant, is the range of mountains that forms one side of the Snake River Basin near Fort Hall. North of this is the wonderful Teton Basin which is also like a meadow. To the southeast the shark-teeth summits of the Grand Tetons are most conspicuous and clearly defined, rising so high above all the other peaks that they stand isolated, monarchs of all."

TAHGEE PASS OR TYGHEE.

Tyghee Pass, named many years ago after the head chief of the Bannock tribe of Indians, leads the traveler out of the Snake River Valley up over hills,

LONE STAR GEYSER, YELLOWSTONE NATIONAL PARK.
Reached via the Union Pacific System.

densely wooded, toward the south fork of the Madison. Hardly has the ascent begun ere he is among groves of cloud-like trembling aspen, whose green and silver leaves, shield-shaped, give a peculiar delicacy of coloring to the scenes. The mountains on either hand are rugged and unique in form. At one place we look into a narrow side glen lorded over by a massive terraced peak, and at another three conical, butte-like mountains catch the sight, so densely covered with timber that it is impossible for the eye to distinguish any separate tree from out the mass, and all the trees of such a uniform height that their green tops make the mountains look as if only grass covered. At the summit of the pass we are on the ridge of the great watershed of the continent—the springs on one hand flowing down toward the Atlantic Ocean and on the other toward the Pacific, amid grasses and tangled fern, but a short distance apart, springs, icy cold, ooze forth and begin their long, separate journeys toward the rising or the setting sun.

The ride through Tyghee Pass is delightful. The density of the pine woods covering the hills is wonderful to see, and wherever an open glade occurs it is richly green. A writer says: "There is one peculiarity of the tree vegetation all over this portion of the West—that it has a fresh, young look. The pines are seldom more than two feet in diameter, sending up a straight stem 100 to 150 feet high, and a large aged pine, or tree of any kind, is a landmark as well as a curiosity."

Such a curiosity is the group of hemlocks at the top of the pass. The writer already quoted describes them: "In this pass there is a group of huge hemlocks that will at once arrest the traveler's attention. They seem to belong to another age. There are ten of them, and several others have perished. They are from four to six feet in diameter and rise to a height of 150 feet. This group of trees is the more conspicuous from the fact that they are larger than any others in this region, and have a very ancient appearance."

From the top of the pass we speed down, through groves of pine innumerable and over the border line of Idaho and Wyoming, to camp by the bright, sparkling stream of the Madison.

A noon halt is made at the South Fork of the Madison, close beside its dark blue waters as they come springing down over mossy boulders from the sun peaks to the south. The stream is cold and flashing at this point, and lower down where it debouches into the cut, it is "beautiful in its quiet flow—the water is shallow, clear, and at the bottom the bright vegetation may be seen like little green islands." Fish and game abound along its course, the mountain herring, graylings, whitefish and trout being all caught in the Madison.

From the station the road is one of the finest in the world, for a distance of twelve miles passing over gently rolling hills, clumps of aspen and pine trees alternating and giving a park-like appearance to the landscape. At Riverside we again cross the Madison, which then disappears on the left through a deep mountain gap, and the road ascends some hills directly in front. An extended backward view is obtained during the afternoon, which embraces endless chains of hills and mountains, all their outlines clearly defined, in the afternoon sunlight, but growing dimmer and dimmer with distance, those most remote seeming but thin veils of gauze stretched across the lower sky.

Before entering the park we pass through long lanes, cut through the pine woods; the road rises and falls like a monster serpent. Our first sight of a geyser will be perhaps at the end of one of these long vistas, and thus seen will never be forgotten. Besides the sights witnessed while *en route* the traveller is more than repaid for his stage journey by the first sight of the Lance Geyser Basin as the coach arrives at sunset at the brow of the overhanging hill. Before his sight will suddenly appear a strange spectacle, a narrow valley, with Fire Hole River winding through it. Long rows of campers' tents, horses cropping on the grassy meadows, evening campfires being lit, and all the busy preparations for approaching night engaging the attention of the campers. But back of this always pleasing scene, a marvel—water spouting from the earth, and columns of steam, and steam hovering overhead in clouds.

Geyser Meadows are two miles away. Here are several geysers which throw their torrents twenty-five feet or higher. Dome Spring is at the top of a calcareous deposit of livid colors, and some of its neighbors are similarly situated. "Queen Laundry" is a spring whose waters will almost instantly cleanse even the dirtiest saddle blanket, and which finally drop into a basin at delightful bathing temperature. Fairy Creek Falls jump 220 feet over an adjacent cliff. With these spouting, leaping novelties all about, Midway Geyser Basin is reached five miles from Fire Hole Basin. Here are the grandest hot springs in the world. The overflow of hot water comes from the Great Spring, the equal of which no human eye ever say. This aperture is 250 feet across and is walled in by sides thirty feet high. The surface is in constant turmoil, and the rising steam scalds the incautious. A glance into the gulf causes a shudder. Only a few yards away there is a cold fount twenty-five feet in diameter, filling an elaborately-chased basin of unknown depth. Near by are the Chalk Vats, bubbling and spurting their mushy compound, and throwing out splashes of it which vary from a snowy white to a bright pink.

Upper Geyser Basin, eight miles from Fire Hole Basin, is the seat of the ten largest geysers ever discovered, besides which those of Iceland are trifling. There is a charming grove within a stone's-throw of Castle Geyser, which begins to give vent to its pent up force in muttered thunder, and then its flood shoots over the cone, first a spurt and then a stream; then with a shaking of the earth and the roar of a tempest, a river bounds upward like a rocket, submerging broad acres with the descent of its boiling flood. Half a mile away "Old Faithful" spouts every fifty-seven minutes, throwing a stream several feet in diameter to a height of 200 feet. Across the river is the "Bee Hive," whose fountain flies 200 feet in the air, forming a crystal arch beautiful in the sunlight. "The Giantess" has a crater eighteen by fifteen feet in diameter, belching forth such a volume as doubles the amount of water in Fire Hole River, here twenty feet in width and a foot deep. There is a thrill, a groan, a tremor, dense volumes of steam, a rolling

and clashing of unseen waves, and a deafening boom as an immense body of water is hurled upward to the sky, its extreme jet reaching 250 feet above the earth.

Next is Gibbon Falls, where, in a wildwood tangle, they drop eighty feet; then Gibbon Cañon, with its sides 2,000 feet high, from which the tourist emerges into Elk Park. In the defile is heard a boom, boom, boom, that never ceases, and from an orifice in the rock comes steam in regular puffs as the pulsation of a great waste pipe of an engine. Monument Geyser and the famous Paint Pots, with their varied and vivid hues, are near by. Norris Geyser Basin is the next in order. It is the oldest basin in the park, the hottest and most dangerous for pedestrians. To the right is Mammoth Geyser; when at a rest a peep may be had into its gaping throat, and its blood-chilling gurgle can be distinctly heard.

Yellowstone Lake is twenty-five miles from Fire Hole Basin. The altitude of this lake is 7,788 feet. It is thirty miles long and ten to fifteen wide, with numerous islands.

The Natural Bridge of Rock spans Bridge Creek at a height of forty feet and affords carriage room. Down the river twelve miles is Devil's Den; east of this is Mud Volcano. Brimstone Mountain is three miles below. Here pure sulphur is shoveled up by the wagon-load.

The Upper Falls of the Yellowstone are reached by an easy trail. Here the rapids narrow to less than 100 feet, and the overhanging rocks press so closely together that a bridge could be easily thrown across. The water eddies and cascades, and then flies downward 397 feet, while the grandest cañon of the world stretches away 1,500 feet below. The mind cannot grasp Grand Cañon; words cannot paint it; it glows with a life of its own, and with colors of its own, or born of the sun and the spray. Tower Falls and Cañon are twenty miles from this charming spot. Specimen Mountain is forty miles from Fire Hole Basin. It is covered with agate, once wood, stone snakes and fishes, with crystals and petrified roots, while the view from the summit is sublime.

And this is Yellowstone National Park. Words cannot convey a proper realization of its grandeur and magnificence. Nowhere else in America are

there such superb views as the Park affords; nowhere else such an abundance of finny game; nowhere else such myriads of wild fowl; nowhere else such a delightful camping place, or more perfect weather.

GEYSERS.

BY WALTER HARVEY WEED, U. S. GEOLOGICAL SURVEY.

Early in the present century the attention of scientific men was attracted to Iceland by stories of wonderful fountains of steam and hot water found in that country, and such was the interest which these unique curiosities of Nature aroused throughout Europe that several expeditions were sent to Iceland to study the phenomena. To these fountains the Icelanders gave the name of geysers, the term being derived from the verb *geysa*, signifying to gush.

A geyser may be defined as a hot spring which intermittently ejects a column of boiling water and steam. However no sharp line of distinction can be drawn, since in all geyser regions there is every gradation, from the quiet pool of warm water to a boiling, steaming spring which is intermittently agitated, and from the latter to a full-fledged spouting geyser. In the present paper I shall attempt to give an account of the general features of these beautiful fountains without treating the many interesting questions which come up in a discussion of the subject.

In looking at the distribution of geysers in various parts of the world one is quickly impressed with their great rarity. Hot springs abound in many countries, but boiling springs are characteristic only of regions of recent (that is geologically recent) volcanic activity; it is only in such regions that geysers occur. Until late in this century Iceland was the only land where geysers had been found. Less than forty years ago they were discovered in considerable numbers in New Zealand, and since then a few others have been reported from other parts of the world. The "Geyserland" of the world is undoubtedly, however, the Yellowstone National Park, a region situated in the heart of the Rocky Mountains, at the headwaters of the Missouri and Yellowstone, and discovered so late as 1869.

In order to bring before the reader a general idea of the true relation of geyser vents to the surrounding topography and water-courses of the districts, a brief description of the three great geyser regions of the world will be attempted. It has been my good fortune to have spent seven summers at the various geyser "basins" of the Yellowstone in connection with my duties as Assistant Geologist on the U. S. Geological Survey party under Arnold Hague. The other regions are familiar through the descriptions of friends who have seen them and the writings of other visitors to those countries.

Iceland has already been alluded to as the birthplace of the word geyser. It has been called the land of frost and fire, and in no place are the evidences, nay, the very forces themselves, of frost and fire brought so forcibly in contrast. The island is eminently a volcanic region, a central tableland with sharp volcanic peaks, hooded with great Jökuls or glaciers, and mantled with perpetual snows, and surrounded by a more or less narrow strip of lowland bordering upon the sea. The evidences of internal fire are unmistakable. Hecla and other volcanoes are occasionally active, and the whole island is covered with lava poured out by the volcanoes.

The source of the heat supplying the geysers is unquestioned. As would naturally be expected from the combination of water and fire, hot springs are abundant and at a few localities geysers are found. The most noteworthy of these is Haukadal, where The Geyser, Strokr and a smaller geyser are found. This locality is about seventy miles from Reykiavik, the Iceland metropolis, and is only reached on horseback over beds of clinkers and rough lava fields; a dreary ride so far as scenery goes, but of fresh novelty to visitors from warmer lands. The hot springs are clustered in an area of about twenty acres, at the base of a hill about an eighth of a mile long and three hundred feet high, and at the edge of the marshy bottom that stretches out toward the Hvita river. The springs are really at the base of the seaward border of the high ground where the waters that have percolated through the tuffs and porous lavas of the higher region would come to the surface. The two geysers, Strokr and The Geyser, issue from mounds of gray or white silica deposited by the hot waters, and

the neighboring springs are surrounded by lesser areas of the same material, while on the hillside back of the springs the rock is decomposed by the steam of fumeroles. These two large spouters show two types of geysers. Strokr has a funnel-like pit thirty-six feet deep and eight feet across, expanding into a saucer-like basin. The tube is generally filled to within six feet of the top with clear water, which boils furiously, owing to the escape of great bubbles of steam coming from two openings in opposite sides of the tube. The eruptions are quite as beautiful as those of its more famous companion, the jets rising in a sheaf-like column to a height of one hundred or more feet, eruptions taking place at very irregular and long intervals; but by putting a lid on this great kettle, by dumping in large pieces of turf an eruption can be produced in a short time.

The Geyser, on the contrary, is a pool of limpid, green water whose surface rises and falls in rhythmic pulsations. The usual temperature is but 170 degrees Fahrenheit or 200 degrees Fahrenheit, but varies, being greater immediately before an eruption. The shallow, saucer-like basin is about sixty feet across the slopes into a cylindrical shaft ten feet in diameter, forming the pipe of the geyser—this is about seventy feet deep. This regularity of the tube becomes important when we consider Bunsen's experiments and the theory of geyser action he deduced from them. Before an eruption bubbles of steam entering the tube suddenly collapse with loud but muffled reports and a disturbance of the quiet surface of the water. During this simmering, for such it is, the water rises in dome-like mounds over the pipe and overflows the basin, running down the terraced slope and wetting the cauliflower-like forms of sinter that adorn it.

The eruptions have varied much in appearance and height since the geyser was first known. At present the column does not exceed ninety feet and the eruption lasts but a few moments. After it the basin is empty and seems to be lined with a smooth coating of white silica.

The geysers of New Zealand are situated in a region clothed with a luxuriant vegetation that is in strong contrast to the bleak and barren lava fields of Iceland, but an examination of the position of the

springs, with respect to the physical features of the region, shows that the situation of the geysers is nearly the same in these antipodal isles. The New Zealand geysers occur in the North Island, in what is known as the volcanic region, or the Taupo zone. Within an area of 4,725 square miles, in which none but volcanic rocks are found, there are six volcanoes, and great numbers of solfataras, fumeroles, mud volcanoes and hot springs, and many geysers. The lavas are all of the acid type, mostly rhyolite, but are hidden by surface-decomposition and an abundant vegetation, save upon flanks of the peaks. The axial line of this zone runs northeast and southwest, each end being marked by an active volcano, and its course by a line of greatest thermal activity. This wavy line of hot springs follows well-marked physiographical features of the country, being characterized by river valleys, low plains and lake margins. On both sides of this central depression, the country is higher, presenting plateaus of 2,000 to 3,000 feet, and eroded into detached 'cut-blocks. Little is known of geysers on the shores of Lake Taupo, or those on the banks of the Waikato river, but the famous terraces of Rotomahana, called the eighth wonder of the world by James Anthony Froude, attracted attention to the geysers which formed them, and made their vicinity the best known part of the district. The warm lake, called by the Maoris, Rotomahana, was a shallow body of warm water, about a mile long, and a quarter of a mile broad, comprising 185 acres. The waters were of a dirty, greenish hue, reflecting the sombre green of the fern and the ti-tree-covered slopes about it, and the sedgy margins sheltered large numbers of duck and other water-fowl. Rising above its surface like stairways of delicately-sculptured marble, were the pink and white terraces. At the top of the terrace, 120 feet above the lake, was the Terata geyser, whose overflow had built up this wonderful work and filled the basins and pools with waters whose tints were both the delight of the eye and the despair of the pen. The geyser caldron was some sixty by eighty feet across, its clear and boiling water usually overflowing, and occasionally ejected to a height of 40 to 100 feet, wetting the steep banks of bright-colored fumeroie clays about the crater, but not forming the beaded geyserite, characteristic of so many of these

fountains. Such eruptions followed a period of quiescence, when the waters retired within the pipe for many hours. Owing to the comparative inaccessibility of the caldron and the beauty of the terraces, but few observations are on record of the action of the geyser. The water carried 150 grains of solid matter to the gallon, of which one-third was silica, and the daily outflow of 100,000 to 600,000 gallons per hour, brought up ten *tons* of solid matter dissolved out of the underlying rocks. It is easy to see what great underground caverns would be formed by this geyser alone in a comparative brief time. In the volcanic outbreak of Tarawera, in June, 1886, the waters of the lake and underground reservoirs were drawn into the newly-opened fissure, and by the extraordinary explosion that followed, the terraces were completely destroyed, and the site of Rotomahara became a crater that threw mud over the surrounding country.

The Yellowstone geysers are, doubtless, familiar to many readers of this paper. The geyser "basins," as the localities are termed, conform, in their relations to the surrounding high ground and their coincidence with lines of drainage and the loci of springs, to the laws governing the distribution of the same phenomena in other parts of the world. The Park itself is a reservation of about 3,500 square miles, the central portion being an elevated volcanic plateau, accidented by deep and narrow cañons and broad gentle eminences, and surrounded by high and rugged mountain ranges. This central portion whose average elevation is about 8,000 feet above the sea, embraces all the hot-spring and geyser areas of the Park. The volcanic activity that resulted in the formation of the Park plateau, may be considered as extinct, nor are there any evidences of fresh lava flows. Yet, the hot springs, so widely distributed over the plateau, are convincing evidence of the presence of underground heat. There is no doubt that the waters derive their high temperatures from the heated rocks below, and that the orgin of the heat is, in some way, associated with the source of volcanic energy.

The usual route of travel through the park, makes the Norris Geyser basin the first of the so-called basins seen. There are many reasons for believing this to be the most recent of the geyser areas of the

world, and here there are several examples of geysers, spouting from fissures in the solid rhyolite.

The greatest geyser of the park, and indeed, the grandest of the whole world, is Excelsior, some twenty-five miles beyond the Norris Basin. Unlike the less capricious and more fountain-like geysers of the Upper Firehole, this monster of geysers does not spout from a fissure in the rock, nor from a crater or cone of its own building. It is a monster of destruction, having torn out its great crater in the old sinter-cover slope, builded by the placid and beautious Prismatic Lake. The walls, formed by the jagged ends of the white sinter layers, which are lashed by the angry waters, are ever undermining the sides and enlarging the caldron. The eruptions are so stupendous that all other geysers are dwarfed by comparison. The grand outburst is preceded by several abortive attempts, when great domes of water rise in the centre and burst into splashing masses ten to fifteen feet high, while the waters surge under the over-hanging walls and overflow the slope between the crater and the river. Finally, with a grand boom or report that shakes the ground, an immense fan-shaped mass of water is thrown up to a height of two hundred or more feet, great clouds of steam rolling off from the boiling water, while large blocks of the white sinter are flung far above the water and fall about the neighboring slopes. It is a sight that inspires enthusiasm in the most phlegmatic, and few can resist the temptation to give loud expression to their feelings. Unfortunately, this monarch of all geysers has ceased to erupt, but may be expected to break forth again at any time.

A few miles beyond Excelsior is a group of geysers that is without a rival. Sentinel, Fan, Cascade, Riverside, Mortar and Grotto, greet one on entering the basin, either by quiet steaming or by flashing jets. Giant, Spendid, Castle, Grand, Giantess, Lion, and Old Faithful are but a few of the wonderous fountains of the place. The last is most deserving of its name. Ever since its discovery in 1870, it has not failed to send up a graceful shower of jets at a regular interval of sixty-five minutes. Its beauty is ever varying, as wind and sunlight play upon it, and the mound about its vent is adorned with delicately-tinted basins of salmon, pink and yellow, filled with limpid

MAMMOTH HOT SPRINGS, LIBERTY CAP, YELLOWSTONE NATIONAL PARK.
Reached via the Union Pacific System.

water whose softness is enticing. It is *the* geyser of the Park and indeed of the world, and many a visitor to "geyserland" departs without seeing any other of the many geysers in action and yet feels more than repaid for the journey. For beauty of surroundings, the Castle will perhaps be awarded the palm. Its sinter chimney, or cone, is formed of exquisite cauliflower or coral-like geyserite whose general form makes the geyser's name appropriate. Its eruptions are frequent, averaging some thirty hours, when a stream of hot water is thrown up to a height of seventy-five feet for some fifteen minutes, followed by the emission of steam with a loud roar that can be heard for miles. A few hours after the eruption the tube is again full, and occasional jets of ten to twenty feet are thrown out until the next eruption ensues.

GEYSER WATERS.

The descriptions which have been given of the chief geyser regions of the world lead to the question: What is the source and character of the geyser waters? It has been plainly indicated that in the fields described, the vents are always situated along lines of drainage, on the shores of lakes, or under conditions where ordinary springs of meteoric water would naturally occur.

That the geyser waters are surface waters which have percolated through the porous lavas, and have been heated by encountering great quantities of steam and gases rising from the hot rocks below, there is no reasonable doubt. The proximity of ordinary cold springs and those of boiling hot water lends support to this view.

These hot waters traversing the rocks in irregular fissures, readily dissolve out the more soluble constituents of the rocks, the amount and the character of the salts present varying somewhat with the nature and amount of gases held in the waters. Chemical analysis of geyser waters from the three regions described show no greater variation than those from different vents in any one of these regions.

SOURCE OF HEAT.

That the source of the steam is the still hot lavas below, and is in some way connected with volcanic action, is so evident from the facts that no other conclusion is possible. A very common belief concern-

ing the source of the heat of boiling springs and geysers, but one which no longer has the support of scientific men, is that the heat results from *chemical action,* as it is vaguely termed. Were not the evidence so directly opposed to this idea, it would merit consideration, but so far as the heat of geyser waters is concerned, all observation shows it to be untenable. To this class of theories belongs the popular idea that the geyser basins are underlaid by great beds of (quick?) lime, which supply the heat and steam of the geysers.

The smothered combustion of beds of lignite, coal or pyrites, is another form of the same theory that has been received with considerable favor, and still commands a few followers. That hot springs may have such an origin is not denied, but the geological conditions and environment clearly show that none of the great geyser regions of the world derive their heat from such action.

Where the source of supply is deep-seated, spring waters always have an elevated temperature, generally proportionate to the depth, but the very high temperatures of geysers and the local source of the waters excludes this theory. The folding and faulting of rocks is another source of heat made manifest by hot springs.

It has been shown by Dr. Peale, however, that *boiling* waters are only found in regions of volcanic rocks, and pointed out by L'Apparent that geysers only occur in *acid* volcanic lavas. In Iceland the volcanic forces are still active, and melted lavas may exist at no great depths. In New Zealand the recent eruption of the eroded mountain Tarawera showed that heated rocks exist, and in that case rose up near enough to the surface to cause the explosion which so transformed the country.

In the Yellowstone there are no active volcanoes, and none of even geologically recent activity. The lavas that fill the ancient mountain-encircled basin of the Park are scored by glaciers and deeply cut by running water, and the old volcanoes from which the lavas were, in part at least, outpoured, show no signs of having been active since Tertiary times. Yet in this region the expenditure of heat by the hot springs, geysers and steam vents would undoubtedly keep a moderate sized volcano in a very active state,

were it concentrated. There is no doubt that this heat is connected with the past volcanic energies of the region, and derived principally from the still hot lavas, three-quarters of the entire area of the Park (3,500 square miles) being covered by rhyolitic rocks.

The significance alluded to above of the association of geysers and acid lavas (rhyolites) is possibly to be found in the fact that these rocks are more easily dissolved by the hot waters forming the tubes and reservoirs for geysers. The situation of hot springs and geysers along water-courses has already been mentioned. It is a well-known fact that the presence of water in the pores of a rock increases its capacity to conduct heat, so that we may surmise a rise in the local isogeotherm in such situations.

GEYSER ERUPTIONS.

Geysers have often been compared to volcanoes, presenting in miniature, with water instead of molten rock, all the phenomena of a volcanic eruption. The diversity of form and varying conditions of activity of the hot springs found associated with geysers, makes it impossible to determine in every case whether a spring is or is not a geyser. Geyser vents may be mere rifts in the naked rock or bowls of clear and tranquil water, quiet until disturbed by the first throes of an eruption, and surrounded by white sinter deposits in nowise distinguishable from those about hot springs. In other cases the vents are surrounded by a cone or mound of pearly beaded "geyserite," a certain and distinctive feature of a geyser.

The displays of the great "Geyser" of Iceland have already been briefly described; they may be taken as the type of eruptions from geysers having bowl-like expansions at the top of the tube, the so-called "basin" of the geyser. Where the vent is surrounded by a cone or sinter, as is so often the case among the fountains of New Zealand and the Yellowstone, the first part of the geyser eruption is somewhat different. Perhaps the most familiar geyser of this type is Old Faithful, the one geyser in the Yellowstone that is sure not to disappoint the visitor. Though surpassed by many of its neighbors in the height and magnitude of its eruptions, it holds a front rank for beauty and gracefulness. Previously heralded by loud rumblings, with spasmodic outbursts

of ten to twenty feet in height, that mark abortive attempts to send up its steaming pillar, the white column is finally thrown upwards with a loud roar, and mounts at once to a height that seems hundreds of feet as we gaze upon it. For two, or even three minutes, the column maintains a height which measurements show to vary from ninety feet up to 150 feet, with occasional steeple-shaped jets rising still higher, the jets ever varying and giving off great rolling clouds of steam ; then the jets gradually decrease in altitude, and in five minutes the eruption is over, the tube apparently empty, and emitting occasional puffs of steam for a few minutes longer.

During the eruption the water falls in heavy masses about the vent, filling the basins that adorn the mound, and flowing off in yellow and orange colored water-ways, while the finer spray drifts off with the breeze and falls upon the neighboring sinter-slopes. It is impossible to measure the amount of water thrown out, since it runs off in a number of directions in shallow rills that lead either to the sandy terrace near by or to the river. If, however, we assume that the column of steam and water is one-third water, a fair assumption, the estimated discharge is 3,000 barrels at each eruption.

Comparing Old Faithful with its Iceland prototype, we find considerable difference in the behavior of the two vents during the interval between eruptions. The former, like Strokr, has no bowl or basin, and the geyser throat or tube is partly filled with water, which is in constant and energetic ebullition, while the geyser is inactive. The tube and bowl of "Geyser" are, on the contrary, filled with comparatively cool water. In each case, however, the eruption is preceded by an overflow from the geyser tube, in the case of Strokr and Old Faithful, as jets of ten feet to twenty-five feet in height; in "Geyser" by a filling of the bowl and successive overflows, accompanied by the noise of condensing steam bubbles, a simmering of the water in the tube. Such preliminary actions are significant when we consider the theory of geyser action.

THEORIES OF GEYSER ACTION.

The intermittent spouting of geysers was long a riddle to scientific men, for although several theories seemed each to offer a satisfactory explanation of the

YELLOWSTONE CANON, FROM FOOT OF FALLS, YELLOWSTONE NATIONAL PARK.

Reached via the Union Pacific System.

eruptions of "Geyser," they supposed conditions unlikely to occur in many vents. The investigations of Bunsen, and of Descloizeaux, who spent two weeks studying the Iceland fountains, resulted in the announcement of a theory of geyser action which, with slight modifications, has satisfied all requirements, and is to-day generally accepted as the true explanation of the action of these natural steam engines. This theory, which bears the name of the illustrious Bunsen, depends upon the well-known fact that the boiling point of water increases with the pressure and is therefore higher at the bottom of a tube of water than at the surface. The temperature of water heated in any vessel is generally equalized by convective currents, but in a long and narrow or an irregular tube this circulation is impeded, and while the water at the surface boils at 100 degrees C. (at sea level), ebullition in the lower part of the tube is only possible at a much higher temperature, owing to the weight of the water column above it.

In illustration of this theory a model geyser is easily constructed of a glass tube of an inch or so in diameter and several feet long. When this tube is closed at one end, filled with water and placed upright, we have all the mechanism necessary to produce all the phenomena of a geyser. By heating the water at the bottom by the introduction of steam (or with a spirit lamp), we can produce eruptions whose period will depend upon the intensity of the heat. At first the bubbles of steam collapse in the cool waters at the bottom of the tube, but as the temperature rises the bubbles rise part way up the tube and heat the lower part of the column to a high temperature while the water near the surface is still cool. Eventually the water at the bottom reaches the pressure boiling point, when steam is formed, lifting the water above it, and causing an overflow at the top. This overflow, or its equivalent, the filling of a shallow basin at the top of the tube, relieves the pressure and all that part of the column whose temperature was previously below the boiling point but now exceeds it, flies into steam and ejects the water above with great violence. The glass walls of our geyser tube permit us to watch the gradual heating of the water by means of thermometers suspended in the tube, the ascent and collapse of steam bubbles, the

overflow and abortive attempts to erupt, and the final ejection of the water from the tube.

Where the tube is surrounded at the top by a basin no actual overflow need occur. Indeed there is in the Yellowstone a miniature geyser, aptly named the Model, with a tube but two inches in diameter, surrounded by a shallow, saucer-like basin, which has eruptions about every fifteen minutes of three feet to five feet in height in which scarcely a drop of water is wasted, but flows back into the tube after the eruption. During the interval between eruptions no water can be seen in the tube, whose basin and upper part are dry and cool. The first signal of the coming display is a quiet welling up of the water in the tube filling the little basin, which being relatively large and shallow relieves the water column of a considerable height. During the eruption which follow the spray is chilled by the air, falling back into the basin; at the end of the display the water is quickly sucked back into the tube and reheated for the ensuing eruption.

At first thought the constant boiling of the waters in the tube of Strokr, Old Faithful and many other geysers seem to oppose the theory which we have just given. Observations show, however, that in many cases the boiling is confined to the surface and deep temperatures do not reach the boiling point corresponding to the depth. It is quite likely, also, that in some cases a lesser and independent supply of heat may connect with the upper part of a geyser tube; Strokr, we know, has two vents, one of which is the geyser tube, the funnel-like throat of Strokr being really but a nozzle to the geyser.

It is unnecessary to describe the numerous other theories of geyser action; they all suppose caverns or systems of chambers and tubes, of definite arrangement, a supposition most unlikely to occur in many cases, and made unnecessary by Bunsen's theory. Local expansions and irregularities of the tube do exist, and to them we owe many of the individual peculiarities of geysers, but such chambers do not form a vital, essential part of the geyser mechanism.

In an excellent *résumé* of the various theories of geyser action, Dr. A. C. Peale states that he believes no one theory is adequate to explain all the phenom-

ena of geyser action, though Bunsen's theory comes nearest to it.

I believe, however, that Bunsen's theory is a perfect explanation if we but admit that the geyser tube may be neither straight nor regular, but of any shape or size, and probably differing very much for each vent. The shape of the bowl or basin exercises but little influence upon the eruption.

ORIGIN OF GEYSERS.

It should be noted that Bunsen's theory of geyser action is quite independent of his theory of geyser formation. The building up of a siliceous tube by the evaporation of the waters at the margin of a hot spring, is a process which may be seen in operation in any of the geyser regions of the world; but it is not a necessary prelude to the formation of a geyser, for a simple fissure in the rock answers equally well, as is shown at the Norris geyser basin in the Yellowstone Park.

The life history of a geyser varies, of course, for each one, but observations show that the following sequence of events often takes place. The hot vapors rising from unknown depths penetrate the rocks along planes of fracture and shrinking cracks, decomposing and softening the rock until the pressure of the steam and water is sufficient to force an opening to the surface, If this opening affords an easier exit for waters issuing at a higher level the fissure is probably opened with a violent ejection of mud and debris; more often the process is a gradual one, accompanying the slow eating away of the rock walls along the fissure. The flowing waters slowly clear out the fissure, forming a tube that permits the freer escape of hot water and steam, while at the same time the waters change from a thick mud to a more or less clear fluid. The spring, at first a simple boiling mud-hole, is now an intermittently boiling spring, which soon develops true geyser action. If the opening of the fissure afforded a new outlet for the waters of some already existing geyser, these changes take place rapidly, and eruptions begin as soon as the pipe is sufficiently cleared to hold enough water. The bare rock about the vent or fissure is soon whitened by silica deposited by the hot waters. This *sinter* may form a mound about the expanded

tube or basin, or, if the vent be small and spray is frequently ejected, it builds up the curious geyser *cones* so prominent in the Yellowstone. In certain cases the building up of these deposits may partially choke the geyser's throat, and cause a diminution of the geyser's energy, whose forces seek an easier outlet. In other cases the eating out of new subterranean water-ways deprives the geyser of its supply of heat, and the vent becomes either a tranquil laug or wholly distinct, while the pearly *geyserite* forming its cone disintegrates and crumbles into fine shaly débris, resembling comminuted oyster shells. Thus there is a slow but continual change in progress at the geyser basins, in which old springs become extinct and new ones come into being and activity.

With few exceptions, where the vents are very new, geysers spout from basins or from cones of white siliceous sinter, or *geyserite*, deposited about the vent by the hot waters. Such deposits are formed very slowly, one-twentieth of an inch a year being an average rate of growth for the deposit formed by evaporation alone. These deposits of sinter are, therefore, an index to the age of the geyser. In many cases these sinter cones are very odd fantastic structures of great beauty while wet by the geyser spray, but becoming white, opaque and chalk-like upon drying. Where the spattered drops fall in a fine spray the deposit is pearly, and the surface very finely spicular. If the spray be course the rods are stouter and capped by pearly heads of lustrous brilliancy. Thus the cone is not only a measure of a geyser's age and activity, but it tells, in a way, the nature of the eruption.

ARTIFICIAL PRODUCTION OF GEYSER ERUPTIONS.

Eruptions of Strokr have, for many years, been provoked by artificial means. The funnel-shaped geyser throat makes it an easy matter to plug it with a barrowful of turf cut in the adjacent marsh. This acts as a cover, confining the steam, which finally overcomes the resistance and produces an eruption. Travelers have also attempted to hasten the eruptions of geysers by throwing blocks of sinter down the tube, but it is evident that such measures can only succeed when the forces of heat and pressure are in a very delicate equilibrium.

In the Yellowstone geyser basins it has been found that geyser eruptions may be hastened or even caused

by the use of soap or lye. The discovery of this extraordinary fact was made in a very curious way. A Chinaman was engaged by the hotel company to wash the soiled linen; thinking to utilize the abundance of hot water provided by nature, a rude canvas building was put up over a small, circular, boiling spring near the edge of the Firehole river. In this spring the partly cleansed and soaped clothes were put to boil, suspended in a wicker basket. All went well until the Chinaman left his bar of soap with the clothes, when the spring suddenly threw out basket, clothes and hot water, wrecking the shanty and starting the Chinaman on a run from a place that was too near the infernal regions for comfort. This eruption, and the observed effect of soap in increasing the ebullition of boiling springs, led to the use of soap to produce eruptions of this boiling but not spouting spring, thenceforth known as the Chinaman.

The success attending the use of soap in this instance suggested to a photographer, F. Jay Haynes, the use of soap, or its equivalent, lye, to hasten eruptions of those geysers of which he desired to obtain photographs, and led to experiments by the Geological Survey showing that eruptions can be produced in many cases of geysers, which have been most capricious in their exhibitions, or have been inactive for weeks or even months. The conditions essential to the successful use of soap or lye for this purpose seem to be that the geyser-tube be small, and the water near its boiling point, if not actually boiling at the surface. Many of the bowls in the Yellowstone possess a temperature at their surface exceeding the theoretical boiling-point for the altitude by one or two degrees. This apparently anomalous fact is not due to the mineral matter held in solution by the hot waters, for the analyses show that amount to be too small to have any appreciable effect, but it is explained by the waters being free from air, it being well known to physicists that water freed from air has an increased boiling-point, because of the greater cohesion of the particles. The effect of the soap is to increase the viscosity of the water, the consequent explosive liberation of steam producing an eruption.

VARIATIONS IN GEYSER PERIODS.

Many geysers are easily mistaken for simple hot or boiling springs, since during the long intervals be-

tween eruptions they present no indications of their true nature.

The interval between eruptions is manifestly dependent upon the two factors of heat and water supply —variations in either or in both affecting the geyser period. It rarely happens that these factors are so constant that the geyser has a definite period. Even in the case of Old Faithful, the most reliable of all geysers, there are very considerable variations in the period, though the average is always constant from day to day.

It sometimes happens that a slight change in the conditions—a lessened amount of heat, or increased amount of water—will cause a cessation of a geyser's eruptions for a long period. This has happened in New Zealand, where the Waikite geyser near Lake Rotorua, inactive for many years, suddenly exploded, scattering blocks of sinter and scalding several Maoris who happened to be near by. The Excelsior, undoubtedly the largest geyser of the world, was not seen in action until 1878, continuing its periodic eruptions till 1882, when it ceased, and did not play again until 1888. Last summer it was again inactive, though the water boiled furiously, bulging up several feet in the centre of the great cauldron.

Observations made in New Zealand have led to the belief that the eruptions of certain geysers were influenced by the barometric pressure, and it is said that certain geysers are only active during the prevalence of a northwest wind. Observations in the Yellowstone show no such correspondence. As a rule, the water-surface exposed is small, and the effect of temperature and pressure would be scarcely appreciable, yet theoretically it is quite probable that, when the forces in a geyser are in a delicate equilibrium, a change of temperature and pressure of the air would be quite sufficient to cause an eruption.

SUMMARY.

It is believed that the facts recorded in this article show :

1st. That geysers occur only in volcanic regions, and in acid volcanic rocks alone. In Iceland and New Zealand the volcanic fires are still active. In the Yellowstone region the lavas are chiefly of preglacial age.

2d. Geysers occur only along lines of drainage, on

shores of lakes or other situations where meteoric waters would naturally seek the surface. Unheated waters are often found issuing in close proximity to geysers.

3d. Geyser waters are meteoric waters which have not penetrated to great depths but have been heated by ascending vapors.

4th. The supply of heat is derived from great masses of lava slowly cooling from a state of former incandescence, heating waters, which, descending to the hot rocks, ascend as highly heated vapors.

5th. The intermittent spouting of geysers is due to the gradual heating of water accumulated in fissures or tubes in the rocks, the only mechanism necessary being a tube, which may or may not have local expansions or chambers.

6th. Geysers may originate in several ways, though most commonly produced by the opening of new waterways along fissure-planes of the rocks, by a gradual eating out of a tube by hot vapors ascending from below.

7th. The thermal activity of geyser regions is not rapidly dying out. The decrease of heat is very slow, and though changes take place from year to year, the establishment of new geysers and new hot springs offsets the decay or drying up of old vents.

SOAPING A GEYSER.

A few years ago tourists amused themselves by soaping many of the geysers in the park and watching the commotion which the foreign substance created. A very instructive and entertaining paper on the subject of "Soaping Geysers," by Mr. Arnold Hague, of the United States Geological Survey, was read before the American Institute of Mining Engineers at New York in February, 1889. Mr. Hague's essay is at once so scholarly, and so interesting, that it is worthy of permanent preservation, and is inserted herewith in full:

"At the Buffalo meeting, October, 1888, Dr. Raymond presented a paper entitled, 'Soaping Geysers,' in which he called attention to the use of soap by tourists to cause eruptions of several of the well-known geysers in the Yellowstone Park. Incorporated in this paper appears a communication received

from me, written from camp in the park, in reply to some inquiries on the subject. The letter discussed somewhat briefly the means employed by visitors to the park to hasten the eruptions from hot springs and reservoirs of hot water, which remain dormant for days or even weeks or months, at a temperature near the boiling point, without any display of geyser action. As the paper has called forth considerable comment, I desire to elucidate one or two points in relation to the temperature of the springs, and to answer some inquiries about the composition of the thermal waters.

"In the summer of 1885, a Chinaman employed as a laundryman for the accommodation of the tourists at the Upper Geyser Basin, accidentally discovered, much to his amazement, that soap thrown into the spring from which he was accustomed to draw his supply of water, produced an eruption in every way similar to the actual workings of a geyser. Tourists with limited time at their command, who had traveled thousands of miles to look upon the wonders of the Yellowstone, soon fell into the way of coaxing the laundryman's spring into action, to partly compensate them for their sore disappointment in witnessing only the periodical eruptions of Old Faithful. Successful attempts upon this spring soon led to various endeavors to accelerate action in the dormant and more famous geysers. In a short time so popular became the desire to stimulate geysers in this way, the park authorities were compelled to enforce rigidly the rule against throwing objects of any kind into the springs.

"In connection with a thorough investigation of the thermal waters of the Yellowstone Park and the phenomena of the geysers, I undertook a number of experiments to ascertain the action of soap upon the waters, and to determine, if possible, those physical conditions of various pools and reservoirs which permitted the hastening of an eruption by the employment of any artificial methods. This investigation, conducted from time to time as opportunity offered, throughout the field season of 1885, included experiments upon the geysers and hot springs of the Upper, Lower and Norris geyser basins. The results proved, beyond all question, that geyser action could be forced in a number of ways, but most conveniently by the

application of soap. The greater part of the more powerful geysers undergo no perceptible change with a moderate use of soap, although several of them may, under favorable physical conditions, be thrown at times into violent agitation. In most of the experiments Lewis' concentrated lye, put up in half-pound cans for laundry purposes, was employed. Each package furnished a strong alkali, equivalent to several bars of soap. In this form alkali is more easily handled than in bars of soap, more especially where it is required to produce a viscous fluid in the larger reservoirs, and in conducting a series of experiments for comparative purposes, it seems best, in most instances, to employ the same agent to bring about the desired results.

"Old Faithful, the model geyser of the park, exhibits such marked regularity in its workings that attempts to hasten its action appear futile. The interval between eruptions is about sixty-five minutes, and rarely exceeds the extreme limits of fifty-seven and seventy-two minutes. After an eruption of Old Faithful the reservoir fills up gradually, the water steadily increases in temperature; and conditions favorable to another eruption are produced under circumstances precisely similar to those which have brought about the displays for the past eighteen years, or as far back as we have authentic records. The few experiments which have been made upon Old Faithful are insufficient to afford any results bearing on the question; but it seems probable that soon after the water attains the necessary temperature an eruption takes place.

"Of all the powerful geysers in the park, the Bee-Hive offers the most favorable conditions for producing an eruption by artificial means, all the more striking because the natural displays are so fitful that they cannot be predicted with any degree of certainty. Observations extending over a period of several years have failed to determine any established law of periodicity for the Bee-Hive, even for three or four consecutive months, although they indicate that some relationship may exist between its display and those of the famous Giantess. Frequently the Bee-Hive will play several times a day and then become dormant, showing no signs of activity for weeks and months; although the water may stand above the boiling point

the greater part of the time. The name Bee-Hive was suggested by the symmetry of the cone built around the vent. It rises about four feet above the sloping mound of geyserite, and, in cross section, measures about three feet at the top, while at the bottom of the cone the vent is less than ten inches in width. From the top of this narrow vent it is only possible to sink a weight seventeen feet before striking a projecting ledge, which interferes with all examination of the ground below. The constant boiling and bubbling of the water, the irregularity of its action, and the convenient location of the geyser, within an easy walk from the hotel, make attempts to accelerate the eruptions of the Bee-Hive most attractive to tourists.

"In most instances such efforts are futile; yet success does so frequently reward the astonished traveler that, unless the geyser were carefully watched by the authorities, attempts would be made daily throughout the season. If the conditions are favorable to an eruption, it usually takes place in from ten to twenty-five minutes after the addition of laundry soap or lye. It is doubtful if more than two eruptions of the Bee-Hive has ever been produced on the same day by artificial means, although I know of no reason, based upon the structure of the geyser, why more displays might not be obtained, for the reservoir and vent fill up with boiling water very rapidly after each eruption.

"Although the Giantess is situated only 400 feet from the Bee-Hive, these two differ in surface and underground structure and mode of action as widely as any two of the more prominent geysers of the park. Around the Giantess no cone or mound has formed. The broad basin is only partially rimmed in by a narrow fringe of siliceous sinter, rising above and extending out over the deep blue water. At the surface this basin measures about fifteen to twenty feet in width, by twenty to thirty feet in length. It has a funnel-shaped caldron thirty feet in depth, ending in a vertical vent or neck twelve feet deep, through which a sounding-lead may be dropped into a second reservoir, meeting a projecting ledge or obstruction of some kind, sixty-one feet below the surface. After an outburst of the Giantess, the basin, which has been completely emptied of its water, gradually fills

again to the top, and, for days before another eruption, a steady stream of hot water overflows the brim. The intervals between the eruptions of the Giantess vary from twelve to twenty days, and the displays last several hours, being unsurpassed for violence and grandeur by any geyser in the Upper Basin. Artificial means have never been successful in bringing this geyser into action; although, for days before an eruption, it is an easy matter to cause an agitation of the water by throwing into the basin small pieces of sinter, or to produce a boiling on the surface, lasting several minutes, by simply stirring the water with a stick.

"The Giant, one of the most violent of the geysers in the Upper Basin, more closely resembles the Bee-Hive than any other of those along the Fire Hole River. It has built up a cone ten feet in height, one side of which has been partly broken down by some eruption more violent than any witnessed at the present day. Through this notched side, steam and broken jets of water are constantly emitted; and, on this account, but little examination has been made of the underground reservoirs and vents. The Giant is fitful in its action, at times playing with considerable regularity every fourteen days, and at other times lying dormant for nearly a year. I have no positive knowledge that an eruption of the Giant has ever been produced by any other than natural causes. At the time of my experiments, no eruption of the Giant had taken place for several months, although the water was constantly agitated, so much so that it was quite impossible to examine the vent with any satisfactory results. The only effect produced by the application of lye was additional height to the column of water thrown out, and a decided increase in the thumping and violence of the boiling.

"In the Lower Basin the Fountain has been more carefully studied than the other geysers; and, its action and periodicity of eruptions having been fairly well ascertained, it afforded the most favorable conditions for observing the action of soap and lye upon the waters. In its general structure the Fountain belongs to the type of the Giantess, having a funnel-shaped caldron which, long before an eruption, overflows into an adjoining basin. At the time of my experiments upon the Fountain, the intervals between

eruptions lasted about four hours. This interval allowed sufficient time to note any changes which might take place. My own experiments with lye yielded no positive results, although it seemed highly probable that action might be hastened by the application of soap or lye just before the time for an eruption, or when, for some cause, the eruption was overdue. I preferred to make an attempt to bring about an explosion before the usual time, only waiting until the water in the pool had nearly reached the boiling-point. All experiments failed. The previous year, when wishing to produce action for the purpose of photography, I was enabled to accomplish the desired result by vigorously stirring, with a slender pole, the water near the top of the vent connecting with the lower reservoir. In this instance, it should be said, the usual interval of time between eruptions had long since passed; the geyser was., so far as time was conconcerned, a half-hour over-due. My opinion now is that the experiments with lye failed because the temperature had scarcely reached the boiling-point.

"The Monarch, in the Norris Basin, is quite unlike those already described, and affords evidence of being a much newer geyser. It is formed by two convergent fissures, on the line of a narrow seam in the rhyolite, probably coming together below the surface. The main vent measures about twenty feet in length and, at the surface, three feet in width. But slight incrustation is found around the vent, the conditions not being very favorable to deposition. In this narrow fissure the water, which ordinarily stands about fifteen feet below the surface, constantly surges and boils, except immediately after an eruption. The intervals between eruptions vary somewhat from year to year; but, at the time of these experiments, the action was fairly regular, the geyser playing every four hours. I was successful in obtaining an eruption quite equal to the natural displays, which throw a column of water fifty feet into the air. Here at the Monarch there is no surface reservoir, and the narrow fissure filled with loose blocks of rocks, around which the water is in constant agitation, prevents all measurements of depth.

"The results of the many experiments, not only upon active geysers, but upon a large number of hot springs, determines fairly well the essential conditions

which render it possible to bring about geyser-action by artificial means. Negative results are frequently as valuable for this inquiry as experiments yielding imposing displays.

"Outside of a few exceptional instances, which could not be repeated, and in which action was probably only anticipated by a few minutes in time, geyser eruptions produced by soap or alkali appear to demand two essential requirements. First, the surface-caldron or reservoir should hold but a small amount of water, exposing only a limited area to the atmosphere; second, the water should stand at or above the boiling point of water for the altitude of the geyser basin above sea-level. The principal factor which makes it possible to cause an eruption artificially is, I think, the superheated and unstable condition of the surface-waters. Many of the geysers and hot springs present the singular phenomena of pools of water heated above the theoretical boiling-point, and, unless disturbed, frequently remain so for many days without exhibiting any signs of ebullition. It may not be easy to describe accurately these superheated waters; but any one who has studied the hot springs and pools in the park, and carefully noted the temperatures, quickly learns to recognize the peculiar appearance of these basins when heated above the boiling-point. They look as if they were "ready to boil," except that the surface remains placid, only interrupted by numerous steam bubbles, rising through the water from below, and bursting quietly upon reaching the surface.

"Marcet, the French physicist, has specially investigated the phenomena of superheated waters, and has succeeded in attaining a temperature of 105 degrees C. before ebullition. Superheated waters in nature, however, appear to have been scarcely recognized except during the progress of the work in the Yellowstone Park, in connection with a study of the geysers. The altitudes of the geyser basins above sea-level have been ascertained by long series of barometric readings, continued through several seasons. In conducting a series of observations upon the boiling-points of the thermal waters in the park, Dr. William Hallock, who had charge of this special investigation, determined the theoretical boiling-point by noting the mean daily readings of the mercurial

column. The exact boiling-point of a pure surface-water, obtained from a neighboring mountain stream and the boiling-point of the thermal waters from the springs, were determined from actual experiments by heating over a fire, employing every possible precaution to avoid sources of error. Surface-waters and deep-seated mineral waters gave the same results, and coincided with the calculated boiling-point at this altitude. Hundreds of observations have been carefully taken where the waters in the active and running springs boiled at temperatures between 198 degrees and 199 degrees Fahrenheit.

"As will be shown later in this paper, the thermal waters are solutions of mineral matter too dilute to be affected to any appreciable extent as regards their boiling-point by their dissolved contents. The theoretical boiling-point for the springs and pools in the Upper Geyser Basin may be taken at 92.5 degrees C. (198 degrees Fahrenheit). In many of the large caldrons, where the water remains quiet, a temperature has been recorded of 94 degrees C. (201.2 degrees Fahrenheit) without the usual phenomena of boiling. This gives a body of superheated water, with a temperature at the surface 1.5 degrees C. (2.7 degrees Fahrenheit) above the point necessary to produce explosive action. Thermometers plunged into the basins show slightly varying temperatures, dependent upon their position in the basin. They indicate the existence of numerous currents, and a very unstable equilibrium of the heated waters, which are liable, under slight changes, to burst forth with more or less violence. It is under these conditions that geyser-action can be accelerated by artificial means. If, into one of these superheated basins, a handful of sinter pebbles be thrown, or the surface of the water be agitated by the rapid motion of a stick or cane, or even by lashing with a rope, a liberation of steam ensues. This is liable to be followed by a long boiling of the water in the pool, which in turn may lead to geyser-action. There is some reason to believe that, at least in one instance, an eruption has been brought about by a violent but temporary gust of wind, which either ruffled the water or disturbed the equilibrium of the pool, and changed momentarily the atmospheric pressure.

"In Iceland, travelers have long been accustomed

to throw into the geysers turf and soft earth from the bogs and meadows which abound in the neighborhood, the effect produced being much the same as that of sinter pebbles and gravel upon the geysers in the National Park. So well was this understood, that at one time, a peasant living near the Iceland locality kept a shovel solely for the accommodation of those visiting the geysers.

"In my letter to Dr. Raymond, I mention the curious fact that the laundryman's spring, now known as the Chinaman, in which geyser-action may most easily be produced by artificial means, has never been regarded by the Geological Survey as anything but a hot spring, and no one has ever seen it in action without the application of soap, except in one instance, when it was made to play to a height of twenty feet, after stirring it vigorously with a pine bow for nearly ten minutes. In our records it is simply known as a spring.

"If soap or lye is thrown into most of the small pools, a viscous fluid is formed; and viscosity is, I think, the principal cause in hastening geyser-action. Viscosity must tend to the retention of steam within the basin, and, as in the case of the superheated waters, where the temperature stands at or above the boiling-point, explosive liberation must follow. All alkaline solutions, whether in the laboratory or in nature, exhibit, by reason of this viscosity, a tendency to bump and boil irregularly. Viscosity in these hot springs must also tend to the formation of bubbles and foam when the steam rises to the surface, and this in turn aids to bring about the explosive action, followed by a relief of pressure, and thus to hasten the final and more powerful display. Of course, relief of pressure of the superincumbent waters upon the column of water below the surface basin is essential to all eruptive action. These conditions, it seems to me, are purely physical. Undoubtedly, the fatty substances contained in soap aid the alkali in rendering the water viscous. On the other hand, when concentrated lye is used, it acts with greater energy, and furnishes a viscous fluid where soap would yield only surface suds, insufficient to accomplish any phenomenal display.

"It is well known that saturated solutions of mineral substances raise the boiling-point very consider-

ably, the temperature having been determined for many of the alkaline salts. In general, I believe the boiling-point increases in proportion to the amount of salt held in solution. Actual tests have shown that the normal boiling-point of siliceous waters in the park does not differ appreciably from the ordinary surface-waters, mainly, I suppose, because they are extremely dilute solutions.

"The amount of lye required to produce a sufficiently viscous condition of the waters, increases but slightly the percentage of mineral matter held in solution.

"All the waters of the principal geyser basins present the closest resemblance in chemical composition, and, for the purposes of this paper, may be considered as identical in their constituents. They have a common origin, being, for the most part, surface-waters which have percolated downward for a sufficient distance to come in contact with large volumes of steam ascending from still greater depths. The mineral contents of the hot springs are mainly derived from the acid lavas of the park plateau, as the result of the action of the ascending steam and superheated waters upon the rocks below. These thermal waters are essentially siliceous alkaline waters, carrying the same constituents in somewhat varying quantities; but always dilute solutions never exceeding two grams of mineral matter per kilogram of water. When cold, they are potable waters, for the most part slightly alkaline to the taste, and probably wholesome enough, unless taken daily for a long period of time.

"The following analysis of three geyser-waters, selected from the Upper, Lower, and Norris geyser basins, may serve to show the composition of all of them, the differences which exist being equally well marked in the analysis of any two waters from the same geyser basin:

	Bee-Hive Geyser.		Fountain Geyser.		Fearless Geyser.	
	Grams per kilo. of water.	Per cent. of total matter in solution.	Grams per kilo. of water.	Per cent. of total matter in solution.	Grams per kilo. of water.	Percent. of total matter in solution.
Silica	0.3042	25.12	0.3315	23.69	0.4180	25.60
Sulphuric A'd	0.0271	2.24	0.0195	1.39	0.0367	2.25
Carbonic Acid	0.0920	7.60	0.2307	16.48	0.0046	0.28
Phosph'ic A'd			0.00004			
Boracic Acid	0.0145	1.20	0.0138	0.99	0.0223	1.36
Arsenious A'd	0.0011	0.09	0.0027	0.19	0.0022	0.14
Chlorine	0.3894	32.15	0.3337	23.84	0.6705	41.06
Bromine	Trace.		0.0004	0.03	0.0026	0.16
Iodine						
Fluroine						
Hydr. Sulph.			Trace.		Trace.	
Oxyg'n (Basic)	0.0364	3.00	0.0654	4.67	0.0113	0.70
Iron	Trace.		0.0002	0.01	0.0006	0.04
Manganese			Trace.			
Aluminum	0.0029	0.24	0.0057	0.41	0.0002	0.01
Calcium	0.0039	0.32	0.0014	0.10	0.0092	0.56
Magnesium	0.0002	0.02	0.0010	0.07	0.0001	0.01
Pottassium	0.0213	1.76	0.0379	2.71	0.0415	2.54
Sodium	0.3118	25.74	0.3522	25.16	0.4046	24.77
Lithium	0.0061	0.50	0.0035	0.25	0.0081	0.50
Ammonium	0.00021	0.02	0.00015	0.01	0.00025	0.02
Cæsium					Trace.	
Rubidium					Trace.	
	1.21111	100.00	1.39979	100.00	1.63275	100.00

Bee-Hive Geyser, Upper Geyser Basin; date of collection, September 1, 1884; temperature, 199.4 degrees Fahrenheit; reaction, alkaline; specific gravity, 1.0009.

Fountain Geyser, Lower Geyser Basin; date of collection, August 24, 1884; temperature, 179.6 degrees Fahrenheit; reaction, alkaline; specific gravity, 1.0010.

Fearless Geyser, Norris Geyser Basin; date of collection, August 18, 1884; temperature, 190.4 degrees Fahrenheit: reaction, neutral; specific gravity, 1.0011.

"The differences of temperature shown in these three waters are simply due to the varying interval between the time of collection and the last preceding eruption of the geyser. In the case of the Fountain, the water rises in a large, open basin, which slowly fills up, increasing in temperature until the time of the eruption, the form of the basin permitting the

collection of the water two or three hours before the next outburst. In the case of the Fearless, the surface-reservoir is a shallow saucer-shaped basin, into which the water seldom rises before attaining a temperature near the boiling-point. At the Bee-Hive, the water only reaches a sufficiently high level to permit of its collection without difficulty when the temperature stands at or near the boiling-point.

"Dr. Raymond has made the suggestion that the addition of caustic alkali would possibly precipitate some of the mineral ingredients found in these waters, thereby changing their chemical composition sufficiently to affect the point of ebullition. At the same time he remarks that the geyser-waters are probably too dilute solutions to be much influenced by such additions. Anyone who glances at the analysis of the waters of the Bee-Hive, Fountain and Fearless, must see, I think, that they are not only too dilute to undergo any marked change of temperature, but that the mineral constituents consist mainly of the carbonates and chlorides of the alkalies, associated with a relatively large amount of free silica which would remain unacted upon by caustic alkali. There is nothing in the waters to be thrown down by the addition of alkali, or permit any chemical combinations to be formed by the addition of a small amount of soap. The desire of tourists to "soap a geyser," during their trip through the park, grows annually with the increase of travel, so much so that there is a steady demand for the toilet soap of the hotels. If visitors could have their way, the beautiful blue springs and basins of the geysers would be "in the suds" constantly throughout the season. Throwing anything into the hot springs is now prohibited by the government authorities. It is certainly detrimental to the preservation of the geysers, and the practice can not be too strongly condemned by all interested in the National Reservation."

This route, with Fire Hole Basin as a center, brings the tourist near the leading attractions.

From Fire Hole Basin—

The Falls of the Madison are six miles.

Foot of Madison Cañon, eighteen miles.

Falls and Cañon of the Gibbon, ten miles.

Monument Geyser, eighteen miles.

Midway Geyser Basin, or "Hell's Half Acre," three miles.

Upper Geyser Basin, eight miles.

Yellowstone Lake, twenty-five miles.

Yellowstone Falls and Cañon, thirty-two miles.

Remember this route, via the Union Pacific Railway from either Council Bluffs or Kansas City, via Cheyenne, Green River, Granger, and Pocatello, to Beaver Cañon, and thence by stage to Fire Hole Basin.

At Beaver Cañon conveyances of any description can be obtained, baggage wagons, tents, camp outfit, bedding and provisions. It will be found pleasanter and more economical to make up a party of four or six for the trip. It will take a camping party ten days to thoroughly do all the many points of interest in the park, including a return trip to the Lower Basin. There is very fine hunting and fishing between Beaver Cañon and the Lower Basin, and all along the line of march.

The following very interesting account of a deadly gas-spring in Yellowstone Park has been furnished this Department by the author, Walter H. Weed, Esq., of the United States Geological Survey. Mr. Weed has been engaged for seven years on government work in the Park, and is thoroughly conversant with the marvels of that wonderful domain :

"DEATH GULCH."

BY WALTER H. WEED, U. S. GEOLOGICAL SURVEY.

The familiar fable of the upsas-tree, living in a valley of death wherein all life was killed by its deadly exhalations and the ground was strewn with the bones of its victims, has been proven, like many a traveller's tale, to be a highly colored and exaggerated account of a natural phenomenon. The upsas-tree is now well known to have poisonous sap, but not poisonous vapors. But the story survives in the accounts given of the Death Valley of Java, which it was long believed no traveller could cross, "wherein every living being which penetrated the valley falls down dead, and the soil is covered with the carcasses of tigers, deer, birds, and even the bones of men, all

killed by the abundant exhalations of carbonic-acid gas with which the bottom of the valley is filled." Such is the description given by Lyell of this famous valley; while another locality is described as a place where "the sulphurous exhalations have killed tigers, birds and innumerable insects, and the soft parts of these animals are perfectly preserved, while the bones are eroded and entirely destroyed. The researches of Junghuhu have shown that these accounts are much exaggerated, the "valley of death" being a funnel-shaped depression but one hundred feet in diameter, instead of a valley half a mile across. In the bottom of this depression there is hole about fifteen feet in diameter, from which gaseous emanations are given out, which at times accumulate to a depth sufficient to envelop and suffocate animals on the bottom of the hollow. Repeated visits by Junghuhu, extending over a period of twelve years, showed that the amount of gas varied greatly from time to time, but rarely ever rose over two feet and a half above the bottom. At the time of his earlier visit, he found the body of a Javanese native in the depression, but experienced no difficulty or oppression while there himself. This same body was still undecomposed, owing to the preservative effect of the layer of gas, when he repeated his visit eighteen months later. The only other remains seen during his subsequent visits were the carcasses of six swine which were decomposed and putrid. At this time the absence of the gas was shown by the presence of a crow feeding upon the dead bodies.

Though thus shorn of much of its former glory, this Pakaraman, or poison-hole, is the largest and most dangerous of the gas-springs or mofettes of Java, and indeed of the world, and really deserves the title of a natural death-trap. Though such emanations are common in all volcanic regions, this has been the only place known where the gases have accumulated, and caused the death of the larger animals.

In the Yellowstone National Park, now so well known as the wonderland of America, there is a place equalling this famous death valley, and where the gaseous exhalations have proved fatal to numerous bear, elk and many smaller animals.

This place, to which the appropriate name of

"Death Gulch" is given, was discovered by the writer during the summer of 1888, while making a geological examination of the region. It is situated in the extreme northeastern portion of this reservation, a short distance south of the mail-route, which, leaving Lamar River, follows up Soda Butte Creek to the mining-camp of Cooke City. In this region the lavas which fill the ancient basin of the park rest upon the flanks of mountains formed of fragmentary volcanic ejecta, the tertiary andesitic breccias, which rest in turn upon nearly horizontal paleozoic strata; while the hydrothermal forces, which are represented by the geysers and hot springs of the central portion of the park, where the lava-sheet is thicker, show but feeble manifestations of their energy in the almost extinct hot-spring areas of Soda Butte, Lamar River, Cache Creek and Miller Creek. Although hot water no longer flows from the vents of these areas, the deposits of travertine, sinter, and decomposed rock, attest the former presence of thermal springs. Gaseous emanations are now given off, however, in considerable volume, producing extensive alteration in the adjacent rocks, and giving rise to sulphurous deposits.

It is at one of these places that the fatal ravine is found. Situated on Cache Creek, but two miles above its confluence with Lamar river, it is easily reached by a horseback ride of some five miles from the mail station of Soda Butte. The region is, however, rarely visited; for hunting is forbidden in the park, while the place has not been known to present any attraction for the few visitors who pass near it on their way to the well-known Fossil Forests and the weird scenery of the Hoodoo basin.

An old elk-trail, which runs along the north bank of Cache Creek, affords easy traveling, and leads to a little opening in the pine-forest bordering on the stream. In the center of the meadow is a shallow depression, once the bed of a hot-spring pool, now dry, and covered with an efflorescence of salt, making it attractive to the elk and other game of the region as a "lick." The banks of the creek opposite this meadow and below it are covered with ancient hot-spring deposits, which are very dense and hard, and at the borders of the stream have been polished by the action of the water until the surface shines like

glass. A hot-spring cone half washed away by the creek, and a mound of altered travertine on the opposite bank, show the character of the ancient hot-spring water, the rippled surface of the deposit being exactly like that of the beautiful terraces and slopes of the Mammoth Hot Springs. At present, however, the only thermal action is the emission of a little tepid sulphurous water at the edge of the stream. On the other hand, the gaseous emanations are very striking and abundant

In the middle of the creek, which here forms a deep pool about thirty feet across, bordered by the polished calcite already mentioned, the water boils up furiously at several places. This water is, however, quite cold; and the "boiling" is caused by the very copious emission of gas, mainly, no doubt, carbonic acid, though containing some sulphuretted hydrogen, since its smell is quite noticeable, and the water is slightly turbid with particles of sulphur, which also coat the sides and bottom of the pool. Rising through the water of the creek, the great amount of gas given off at this place is easily appreciated, but equally copious emanations may occur from the deposits and old vents near by, which, being invisible, remain unnoticed.

Above these deposits of altered and crystalline travertine, the creek cuts into a bank of sulphur and gravel cemented by this material, and a few yards beyond is the debouchure of a small lateral gulley coming down from the mountain side. In its bottom is a small stream of clear and cold water, sour with sulphuric acid, and flowing down a narrow and steep channel cut in beds of dark gray volcanic tuff. Ascending this gulch, the sides, closing together, become very steep slopes of white decomposed rock, the silicious residue formed by the decomposition of the rocks by acid vapors or waters. The only springs now flowing are small oozes of water issuing from the base of these slopes, or from the channel-bed, and forming a thick, creamy, white deposit about the vents, and covering the stream-bed. This deposit consists largely of sulphate of alumina. The slopes show local areas where sulphur has been deposited by the oxidation of sulphurous vapors, but no extinct hot-spring vents were found. About one hundred and fifty feet above the main stream, these oozing springs of acid water cease; but the character of the

gulch remains the same. The odor of sulphur now becomes stronger, though producing no other effect than a slight irritation of the lungs. The gulch ends, or rather begins, in a "scoop" or basin about two hundred and fifty feet above Cache Creek; and just below this we found the fresh body of a large bear, a silver-tip grizzly, with the remains of a companion in an advanced state of decomposition above him.

Near by were the skeletons of four more bears, with the bones of an elk a yard or two above; while in the bottom of the pocket were the fresh remains of several squirrels, rock-hares and other small animals, besides numerous dead butterflies and insects. The body of the grizzly was carefully examined for bullet-holes or other marks of injury, but showed no traces of violence, the only indication being a few drops of blood under the nose. It was evident that he had met his death but a short time before, as the carcass was still perfectly fresh, though offensive enough at the time of a later visit. The remains of a cinnamon bear just above and alongside of this were in an advanced state of decomposition, while the other skeletons were almost denuded of flesh, though the claws and much of the hair remained. It was apparent that these animals, as well as the squirrels and insects, had not met their death by violence, but had been asphyxiated by the irrespirable gas given off in the gulch. The hollows were tested for carbonic-acid gas with lighted tapers without proving its presence; but the strong smell of sulphur, and a choking sensation of the lungs, indicated the presence of noxious gases, while the strong wind prevailing at the time, together with the open nature of the ravine, must have caused a rapid diffusion of the vapors.

This place differs, therefore, very materially from the famous Death Valley of Java and similar places in being simply a V-shaped trench, not over seventy-five feet deep, cut in the mountain slope, and not a hollow or cave. That the gas at times accumulates in the pocket at the head of the gulch, is, however, proven by the dead squirrels, etc., found on its bottom. It is not probable, however, that the gas ever accumulates here to a considerable depth, owing to the open nature of the place and the fact that the gulch draining it would carry off the gas, which would, from its density, tend to flow down the ravine.

This offers an explanation of the death of the bears whose remains occur, not in this basin, but where it narrows to form the ravine; for it is here that the layer of gas would be deepest, and has proven sufficient to suffocate the first bear, who was probably attracted by the remains of the elk, or perhaps of the smaller victims of the invisible gas; and he, in turn, has doubtless served as bait for others who have in turn succumbed. Though the gulch has doubtless served as a death-trap for a long period of time, these skeletons and bodies must be the remains of only the most recent victims; for the ravine is so narrow and the fall so great, that the channel must be cleared out every few years, if not annually. The change wrought by the water during a single rain-storm, which occurred in the interval between my first and second visits, was so considerable that it seems probable that the floods of early spring, when the snows are melting under the hot sun of this region, must be powerful enough to wash everything down to the cone of *débris* at the mouth of the gulch.

Gaseous emanations are very frequent in volcanic countries, and may be either temporary or permanent. The former are, as is well known, particularly abundant after volcanic eruptions. The gases emitted from fissures in the flanks of Vesuvius are said to have killed thousands of hares and pheasants, and whole herds of cattle have been suffocated by volcanic gas given off near Quito. The permanent emissions of gas, such as the mofettes of Italy, the Laacher See and the Auvergne, remain unchanged, however, for centuries. Where carbonic-acid gas is evolved from a fairly uniform surface, it is quickly diffused into the atmosphere upon the slightest movement of the air; but the case is quite different when the gas is emitted in caves or hollows in the ground. In such places it accumulated, because of its density and slow diffusion, until the hollows are filled to the brim, any excess being quickly diffused as from a level surface. Small hollows of this kind occur in the travertine deposits of the Mammoth Hot Springs of the park, and near the Hot Lakes of the Lower Geyser basin. In these places, small birds, mice, etc., attracted by the warmth of the vapors, or the dead insects, are often suffocated by the gases. Such hollows resemble the mofettes of the Laacher See in Germany, where

dead mice and birds are always found, and are common in other regions as well. The well-known Grotto del Cano, near Naples, is the most familiar example of such accumulations of carbonic-acid gas; and visitors are frequently entertained by the asphyxiation of a poor dog, while the guide, whose head rises above the gas, is not effected by it. Death Gulch is, however, without a peer as a natural bear-trap, and may well be added to the list of the wonders of the Yellowtone Park.

HOW THEY SAW IT.

The practice of presenting testimonials which bear witness to the scenic beauties of a railway route, is, as a rule, to be deprecated; but, from among the thousands received by this department, the two following are selected because they fairly illustrate the feelings of every tourist who has visited that enchanting ground—the Yellowstone National Park.

(From Rev. Dr. J. E. Hurlbut.)

SALT LAKE CITY, July 1, 1889.

We have to thank you for a very pleasant trip to that wonder of wonders—the great Yellowstone Park; my entire party are enthusiastic in their loud praises of every feature of the trip.

We left Salt Lake City at 6 o'clock A.M., via the Utah & Northern division of the Union Pacific Railway, and after a delightful ride by the side of the Great Salt Lake, and through Salt Lake and Cache valleys, we reached Beaver Cañon at 6:30 P.M.

In Bassett Bros, we found men who gave us a good bed at their hotel, the best of food, and every accommodation we could ask for. Their drivers are very accommodating, and add very much to the enjoyment of the trip.

The morning after our arrival we left for the park, driving through an open country. The streams are full of trout, and game is abundant, from bear and antelope to grouse and snipe. After three or three and a half hours' drive, we reached Hancock's, where we got a fine dinner. Driving four hours more, we reached Snake River, where we found very restful beds and appetizing food at the hotels there.

The next day's drive is through the pine woods; game is still plenty.

A ride of four hours brings us to Tyghee Station, where a dinner of extra quality awaited us. Another ride of five hours, and we were landed at Fire Hole in

the park. For the last three hours of this part of the journey, we were in the park limits; and, in crossing the Madison Divide, we enjoyed the finest extended view to be found in the Yellowstone country.

From Fire Hole Basin, we went to the Upper Geyser Basin, passing through "Hell's Half Acre," and visiting Excelsior Geyser, the largest in the world, but not now active, and returned to Fire Hole that night.

The wonderful geysers are seen during this part of the journey—"Old Faithful," that—once an hour—spouts from three to five minutes, throwing a huge stream to the height of 150 feet; "The Castle," whose loud roar gives him a noisy reputation; "The Splendid," which, every three hours on alternate days, throws a stream 200 feet high, and numerous others of lesser note.

The following day we left Fire Hole, and, in a drive of three hours and a half, visited Gibbon Falls and Cañon, Monument Geyser Basin, Gibbon Paint Pot Basin, taking dinner at Norris Basin; and, after a three hours' drive after dinner, reached Mammoth Hot Springs, where we found the largest hotel in the park. On our way, we passed Beaver Lake and the Volcanic Glass Cliffs, and through the Golden Gate, where the skill of an engineer has nailed the road to the side of the cliff.

Returning the next day, we visited the Grand Cañon and the Falls, and every one agreed with me that they are by far the grandest sights in the park.

The next morning we returned to Fire Hole ready to come out, having seen the park as it should be seen.

No one is so near to the Yellowstone as Salt Lake City can afford to miss an opportunity to visit this wonderful spot.

Again we thank you for helping us to make a trip that will never be forgotten by any of us.

(Signed) J. E. Hurlbut,
Miss Hall,
Miss Blodgett,
Miss Merril,
Miss Baker,
Miss Hunt,
Miss Mason, and others.

(From Mr. George N. Smith, India.)

Dear Sir:—Many thanks for your kindness and courtesies and that of your people from Beaver Cañon, in and through the Yellowstone Park. The journey from the Cañon is through a very pleasant country and good road; the hotels on the way are patterns of cleanliness and good food; such mountain trout it has never been my good fortune to meet before; and,

as for the hostelry at Snake River, a sight of the picturesque location would pay for the journey if there were nothing more to be seen. You come upon it so unexpectedly; the river flows close to the door; behind, a dark green pine forest; beyond the river and the uplands, the giant mountains raise their snowy summits. But who can tell the wonders of the park? It was a true report I heard in my own country (India); but the half was never told. Time would fail to tell, had I the ability, of the wonders of the geysers, the exquisite tints of the hot springs, the marvels of the "Formations," and last, but not least, the combined grandeur and beauty of the Grand Cañon of the Yellowstone; gallant "Old Faithful," ever ready to repay the tourist for his journey, by displaying his glorious inverted cataract. The others are rightly named: "Grand," "Splendid," "Giantess," etc. But my affections cling to the "O. F." Listen, the sixty-five minutes are nearly up, wanting only four. Here comes the steam, then a couple of buckets of water; these premonitory symptoms are hardly given when, look out, here it comes! Then nature displays one of her superlatively grand exhibitions; a column of water 150 feet, instinct with life; wave after wave of water pursuing each other upwards in obedience to some mysterious law, setting gravitation at defiance. The Irishman who deprecated his friend's admiration of Niagara by exclaiming "What's to prevent its descent!" would find himself at fault here. Clouds and streams envelop it, thunder accompanies it, and scattered from it 10,000 diamonds fall on every side; but there, I must not belittle it by causing it to be imagined through the refracting medium of my description; it must be seen to be appreciated; it should be seen again and again till its grandeur fills the soul. I should be accused of exaggeration and romance if I attempted to tell of the coloring of the many springs—the Morning Glory, the Gem, the Emerald—so I give it up.

I am exceedingly thankful that it fell to my fortune to see these wonders with my own eyes, and the whole made so pleasant by the amiability of all concerned in the transport. Yours truly,

GEO. N. SMITH.

The Fourth Tour is from Pocatello to Butte and Helena and return. From Pocatello going due north we pass Beaver Cañon, where connection by stage line is made for the Yellowstone National Park; a few miles brings the tourist within the confines of Montana. Passing the water line, Red Rock Station is the first point of interest. Here the scenery is wild, and there is a peculiar formation of points of

jagged land, the highest of which is Red Rock, which juts up some 500 feet, and may be seen in either direction for twenty miles. Then through Dillon, which is in Beaver Head Valley, and one of the thriving towns of Montana, Silver Bow is reached. From Siver Bow the Montana Union Railroad, an auxiliary line of the Union Pacific Railway, branches off, one spur running to Butte City, another through Stuart to Garrison, where connection is made for Helena, and still another from Stuart to Anaconda.

BUTTE CITY.

Butte City, with an elevation of 5,492 feet above sea level, is the largest mining camp in the world, not even excepting Leadville, Colorado. Standing next to the Lake Superior regions in the production of copper, and first of all in silver output, attention has been drawn to it from all over tho world. Butte has a population of 10,723 people, is the possessor of fine hotels and all the modern conveniences of a large city. It is the greatest silver producer, not alone of Montana, but of the Rocky Mountain Mineral belt. It is situated on a gentle slope, and is surrounded by rugged and beautiful scenery, and takes its name from the point known as the Big Butte, located just north of the orignal town. It is ten miles to the main range of the Rockies, but towering foothills have formed the Basin where Butte flourishes. From Butte City, points of interest in Silver Bow, Jefferson and Madison counties can be readily reached. Butte is a healthy place, and blessed with a pure and bracing atmosphere. Butte City presents many attractions to the tourist and health and pleasure seeker.

ANACONDA.

From Stuart, the Montana Union also has a branch to Anadonda. Here is located the largest smelting works in the world, the consumption of coal alone for these works being 300 tons per day. and the yield from copper ore is enormous. From Stuart, the pretty little town of Deer Lodge is but a short distance, and is a point of much interest.

GARRISON.

Further on is Garrison, a place of note, being the junction of the Montana Union branch of the Union Pacific Railway with the Northern Pacific, and formerly the transfer point of passengers going to Portland. But since the opening of the Oregon Short Line, the route is via Huntington, which is the direct line to Portland; the Garrison Routes is used for Helena business.

HELENA.

Helena, the capital of Montana, has an elevation of 4,266 feet above the sea-level, and a population of 13,834. Helena, besides being a great distributing point, is also a mining camp, and is reached over the Union Pacific Railway, via Garrison, and the Northern Pacific Railroad. It is beautifully situated; Fort Benton to the north, Bozeman to the east, Virginia City to the south, with Butte and Deer Lodge to the west. It has fine hotels, clubs, banks, newspapers, street cars—in fact, everything that contributes to city life.

The circumstances attending the birth of Helena are interesting. Four young miners whose names are not associated with the city's latter history, in May, 1864, were wandering along the main range prospecting. They had been unable to obtain claims in Alder Gulch, and their objective point, in case they should fail to strike a rich field of their own, was Kootnai, in British Columbia, where common report located valuable diggings. They camped one night in the gulch where Helena stands to-day, but though they found "color," they were not particularly pleased. They doubted if gold was there in anything like paying quantities. They pushed ahead, therefore, crossed the range, and had gone as many as thirty miles northward when they encountered a man who dispelled their dreams of Kootnai. He said the good claims were all gone,, and the best of them were poor, anyhow. This news was a great discouragement to the party. They had a rather dismal council, and concluded that the gulch they had lately left was their only hope. Accordingly, the next morning they turned around and came back to the spot upon which they had previously encamped.

They grimly named the valley "Last Chance Gulch," and Last Chance Gulch it is to-day. They sank two holes to bedrock, and their hearts leaped high when they counted $3.60 in their first pan. Each of these four adventurers made a fortune from his claim, and soon a big camp was drawn together. One of the miners, who had been impressed with the fascination of Homer's heroine, gallantly urged the name of Helena as most appropriate for the name of the new city, and Helena it became.

It stands to-day in the bottoms where the Last Chance pilgrims made their first discoveries. A more absurd and yet more picturesque situation would be difficult to fancy. Its chief business thoroughfare lies directly in the bottom of the Last Chance Gulch; at the further end of which the patient Chinaman is still washing out his pan of dirt and realizing a fortune larger than, in his own country, he had ever dreamed of acheiving. Thirty millions were taken from Last Chance Gulch before it was abandoned to merchants and shopkeepers, and even now the builder of a new house can find laborers willing to dig his cellar for the dirt they take from it. There are many attractions for the tourist. Mount Helena is to be climbed, and the view from its summit well repays the labor. There are pleasant drives, one of the most popular leading to Hot Springs, four miles away. Prickly Pear Cañon presents attractive features. "The Gate of the Mountains," where the Missouri river bursts through, infinitely surpasses the Hudson Highlands, and for 100 miles down stream there is a succession of pillared hills, of castles, of eroded stone, of caves, and of falls. East of Helena are the White Sulphur Springs, Hell Gate Cañon, and the Devil's Watch Tower. Northwest is Flat Lake, twenty-eight by ten miles, and the Twin Cascades, Elizabeth and Alice, falling 2,000 feet. The return trip is made to Pocatello, where the tourist once more joins the Short Line Division of the Union Pacific. From here the journey is resumed to Oregon, the Dalles of the Columbia, Portland, Tacoma, and Alaska.

STANDARD PUBLICATIONS

BY THE

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The Passenger and Ticket Department of the Union Pacific System will take pleasure in forwarding to any address, free of charge, any of the following publications, provided that with the application is enclosed the amount of postage specified below for each publication. All of these books and pamphlets are fresh from the press, many of them handsomely illustrated, and accurate as regards the region of country described. They will be found entertaining and instructive, and invaluable as guides to and authority on the fertile tracts and landscape wonders of the great empire of the West. There is information for the tourist, pleasure and health seeker, the investor, the settler, the sportsman, the artist and the invalid.

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Crofutt's Overland Guide, No. 1. Send 50 cents.

This book has just been issued. It graphically describes every point, giving its history, population, business resources, etc., etc., on the line of the Union Pacific System, between the Missouri River and the Pacific Coast, and the tourist should not start West without a copy in his possession. It furnishes in one volume a complete guide to the country traversed by the Union Pacific System, and cannot fail to be of great assistance to the tourist in selecting his route, and obtaining complete information about the points to be visited.

From Summerland to the American Alps. Send 4 cents for postage.

This is a short description of that magnificent country traversed by the "Texas Panhandle Route," recently made a part of the Union Pacific System. It will be found a handy volume for southern tourists who intend visiting the North during the summer.

General Folder. No postage required.

A carefully revised General Folder is issued regularly every month. This publication gives condensed through time tables; through car service; a first-class map of the United States, west of Chicago and St. Louis; important baggage and ticket regulations of the Union Pacific System, thus making a valuable compendium for the traveler and for ticket agent in selling through tickets over the Union Pacific.

Gun Club Rules and Revised Game Laws. Send 2 cents for postage.

This valuable publication is a digest of the laws relating to game in

all the Western States and Territories. It also contains the various gun club rules, together with a guide to all Western localities where game of whatsoever description may be found. Every sportsman should have one.

Map of the United States. Send 25 cents for postage.
A large wall map of the United States, complete in every particular, and compiled from the latest surveys; just published; size 46x66 inches; railways, counties, roads, etc., etc.

Outdoor Sports and Pastimes. Send 2 cents for postage.
A carefully compiled pamphlet of some thirty pages, giving the complete rules for Lawn Tennis, Base Ball, Croquet, Racquet, Cricket, Quoits, La Crosse, Polo, Curling, Foot Ball, etc., etc. There are also diagrams of a Lawn Tennis Court and Base Ball diamond. This pamphlet will be found especially valuable to lovers of these games.

Pathfinder. No postage required.
A pamphlet of some sixty pages devoted to local time cards; containing a complete list of stations with the altitude of each; also connections with western stage lines and ocean steamships; through car service; baggage and Pullman Sleeping Car rates and the principal ticket regulations, which will prove of great value as a ready reference for ticket agents to give passengers information about the local branches of the Union Pacific System.

Sights and Scenes. Send 2 cents postage for each pamphlet.
There are six pamphlets in this set, pocket folder size, illustrated, and are descriptive of tours to particular points. The set comprises "Sights and Scenes in Colorado;" Utah; Idaho and Montana; California; Oregon and Washington; and Alaska. Each pamphlet deals minutely with every resort of pleasure or health within its assigned limit, and will be found bright and interesting reading for tourists.

Stream, Sound and Sea. Send 2 cents for postage.
A neat, illustrated pamphlet, descriptive of a trip from The Dalles of the Columbia to Portland, Ore., Astoria, Clatsop Beach; through the Strait of Juan de Fuca and the waters of the Puget Sound, and up the coast to Alaska. A handsome pamphlet containing valuable information for the tourist.

Theatrical Diary. Send 10 cents for postage.
This is a Theatrical Diary for 1892-93, bound in Turkey Morocco, gilt tops, and contains a list of theatres and opera houses reached by the Union Pacific System, seating capacity, size of stage, terms, newspapers in each town, etc., etc. This Diary is intended only for the theatrical profession.

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A handy, neatly gotten-up little memorandum book, very useful for the farmer, business man, traveler and tourist.

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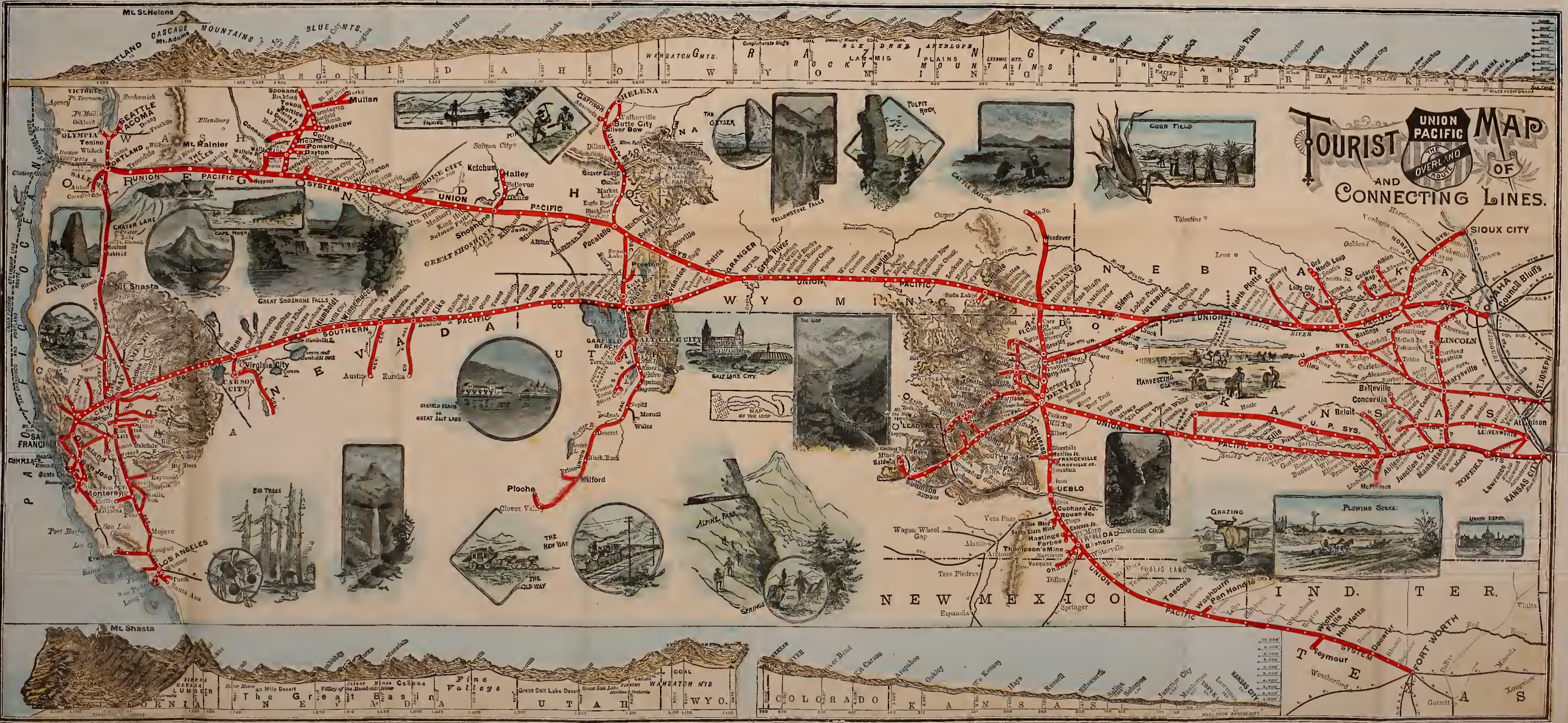
This is a finely illustrated book, describing the vast Union Pacific System. Every health resort, mountain retreat, watering place, hunter's paradise, etc., etc., is depicted. This book gives a full and complete detail of all tours over the line, starting from Sioux City, Council Bluffs, Omaha, St. Joseph, Leavenworth or Kansas City, and contains a complete itinerary of the journey from either of these points to the Pacific Coast.

Wonderful Story. Send 2 cents for postage.
The romance of railway building. The wonderful story of the early surveys and the building of the Union Pacific. A paper by General G. M. Dodge, read before the Society of the Army of the Tennessee, September, 1888. General Sherman pronounced this document fascinatingly interesting and of great historical value, and vouched for its accuracy.



TOURIST MAP OF UNION PACIFIC AND CONNECTING LINES.
UNION PACIFIC THE OVERLAND ROUTE
Mt. St. Helens
CASCADE MOUNTAINS
Mt. Adams
BLUE MTS.
WAHSATCH MTS.
ROCKY MOUNTAINS
LARAMIE PLAINS
PORTLAND
SEATTLE
TACOMA
OLYMPIA
Mt. Rainier
Spokane
Mullan
Moscow
Colfax
Dayton
Pomeroy
BOISE CITY
Ketchum
Hailey
Shoshone
GREAT SHOSHONE FALLS
Pocatello
Carrison
HELENA
Butte City
Silver Bow
GRANGER
Green River
Rawlins
CHEYENNE
Laramie
NEBRASKA
North Platte
Julesburg
Sidney
GRAND ISLAND
Kearney
OMAHA
Council Bluffs
SIOUX CITY
Columbus
Fremont
LINCOLN
Beatrice
Marysville
ST. JOSEPH
Atchison
LEAVENWORTH
KANSAS CITY
TOPEKA
Lawrence
Manhattan
Junction City
Abilene
Salina
Ellsworth
McPherson
DENVER
Boulder
Greeley
Golden
Leadville
PUEBLO
Trinidad
WYOMING
UTAH
NEVADA
IDAHO
KANSAS
COLORADO
NEW MEXICO
IND. TER.
TEXAS
FORT WORTH
Seymour
Henrietta
Wichita Falls
Pan Handle
Tascosa
Decatur
Weatherford
Ogden
SALT LAKE CITY
Provo
Milford
Frisco
Pioche
Clover Valley
Virginia City
CARSON CITY
Reno
Winnemucca
Elko
Humboldt
Austin
Eureka
SACRAMENTO
SAN FRANCISCO
Oakland
San Jose
Monterey
LOS ANGELES
Mojave
Santa Ana
Mt. Shasta
PACIFIC OCEAN
THE GEYSER
YELLOWSTONE FALLS
PULPIT ROCK
CATTLE RAISING
CORN FIELD
CRATER LAKE
CAPE HORN
CASTLE ROCK
GREAT SHOSHONE FALLS
GARFIELD BEACH GREAT SALT LAKE
SALT LAKE CITY.
THE LOOP
MAP OF THE LOOP
BIG TREES
THE NEW WAY
THE OLD WAY
ALPINE PASS
SPRINGS
CLEAR CREEK CANON
GRAZING
PLOWING SCENE
UNION DEPOT
HARVESTING SCENE
FISHING
MINING
The Great Basin
Fine Valleys
Great Salt Lake Desert
CALIFORNIA
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GREAT SHOSHONE FALLS

Sights and Scenes

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